



Building blocks on the sea

simulating the realisation of the M2Cell system in contemporary context of cruise industry



Aalto University
Department of Design
Industrial and Strategic Design Study Programme

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Master of Arts Thesis



Vesa Ylirisku, 2012

Preface

I have been interested in passenger ships and especially ocean liners ever since I was a little boy. The eloquent reflections of the prevailing society trapped in a floating shell of metal through the design and architecture of the vessel and its interior together with the stories of the people onboard captured my imagination from an early age on and has kept me captivated for over three quarters of my life.

A special interest of mine is the late Edwardian era with an unquestioned belief in man's technological supremacy over nature manifested in the *White Star Line's* Greyhounds of the Seas – *Olympic, Titanic and Britannic*. Little did the designers of the great sisters know that the most important features of the grand vessels that “*God himself could not sink*” would be the mistakes and flaws in their design activating a vivid conversation about safety on sea and resulting in numerous improvements in passenger ship design. By becoming the epitome of the era of blind belief in technological supremacy the three sisters opened the eyes of the world for a new century full of trials and errors.

The story of the three sisters with quite a gloomy ending made me feel humble and even a little scared for the privilege to be part of designing a new cruise ship but at the same time I realised that making mistakes in the early stages of the project worked

as the best way to learn and develop the concept further. After all what ever I did in the design process and how ever I tried to make the design look my own, the project will be yet another reflection of our contemporary society with its flaws and peculiarities – just like the one hundred years before.

My sincere thanks go to *Triad* group members Yali Wu and Oliver Parmasto for sharing this project with me, to my tutor Markus Ahola for pushing me forward with the work, to my supervisor Jack Whalen for the skype conversations, to the students and professors of the *Marine Technology* building for accepting a designer in their team, to collaborators in *RCCL* and *STX Finland* for providing guidance, to *Helsingin Messukeskus, Ramirent* and *Shippax* for their precious time, to Bruce Peter for helping me with my critical review of sources in *GSA* and writing extremely inspiring books about ships, to my family for support and understanding and to Alberto Casati for listening to my thoughts and reading my text in the critical moment when all the others above were having their vacation.

Helsinki, 14 September 2012



Author Vesa Ylirisku

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Abstract

Building Blocks on the Sea – Simulating realisation of M2 Cell -concept in contemporary context is a project-based thesis, which main goal is to develop further the adjustable module system called *M2 Cell* by simulating how the concept would work in the context of contemporary cruise industry. In other words, the objective of the thesis is to answer to the need for further research and ideation of the innovative system from the operational point of view.

This thesis is part of the *Cruise and Ferry Experience program's Triad*-project, which brings together three students from three different fields of expertise from the *Aalto University's School Of Engineering, School of Economy and School of Art, Design and Architecture*. The main objective of the attendee group of the project is to produce three Master's theses from three points of view covering the same topic by working in an interdisciplinary environment and having a strong collaboration, through expert interviews and guidance groups, with the real industry.

IDEO's deep dive process was chosen to work as a structural backbone for the whole work, where the first three steps, understand, observe and interpret, are considered as the research part and the iteration circle with four steps, visualise, model, evaluate and specify, are considered as the basic structure for creating scenarios, system map and eventually the simulation.

The outcomes of this thesis are the changing time for one module, the changing frequency of the modules for the whole ship and visualised scenarios and system map for the operation of the cruise ship through different operational areas. The changing time for one module according to the study would be around one hour, but because of all the variables related to the changing procedure, such as the number of cranes and worker groups, the changing time for numerous modules can vary. The maximum time spent for the changing of the modules is twelve hours. The preferred frequency of changing the modules according to the study is half-a-year cycle following the natural seasonal change in operational areas. The scenarios and system map are too complex systems to be explained in this abstract.

The value of this thesis is to give a visualised analysis of the *M2Cell* innovation in operation in contemporary context for the real cruise industry to understand whether the concept is worth further investment and development or not.

Keywords modularity, cruise ship design, system design, macro module



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Tiivistelmä

Building Blocks on the Sea – Simulating realisation of M2 Cell -concept in contemporary context on projektiin pohjautuva opinnäytetyö, jonka perustavana päämääränä on kehittää eteenpäin muunneltavaa moduulisysteemiä nimeltään M2Cell simuloimalla konseptin toimintaa nykyaikaisen risteilyteollisuuden kontekstissa. Toisin sanoen työn tavoitteena on vastata tämän innovatiivisen systeemin kehittämistarpeeseen niin uusien ideoiden kuin yleisen kehittämisenkin kautta keskitettyjen systeemin toiminnallisuuteen.

Opinnäytetyö on osa *Cruise and Ferry Experience* ohjelman *Triad*-projektia, joka tuo yhteen kolme eri alojen maisteriopiskelijaa Aalto yliopiston *Insinööritieteiden korkeakoulusta*, *Kauppakorkeakoulusta* sekä *Taiteiden ja suunnittelun korkeakoulusta*. Projektiin osallistuvan ryhmän tärkeimpänä tavoitteena on tuottaa kolme maisterin opinnäytetyötä samasta aiheesta, mutta kolmesta eri näkökulmasta, työskennellen monitieteellisessä ympäristössä ja yhteistyössä niin asiantuntijahaastattelujen kuin ohjausryhmienkin kautta risteilyteollisuuden kanssa.

IDEO:n Deep Dive prosessi toimi rakenteellisenä selkärankana koko opinnäytetyölle, missä ensimmäiset kolme askelmaa, ymmärtäminen, tarkkailu sekä tulkinta, kuuluivat työn tutkinnalliseen osuuteen ja syklisesti toistuvat neljä askelmaa, visualisointi, mallintaminen, arviointi ja tarkentaminen, kuuluivat systeemin kehittämisosuuteen luoden pohjan skenaarioille, systeemikartalle sekä lopulta koko systeemin simuloinnille.

Opinnäytetyön tulokset ovat yksittäisen moduulin vaihtoajan määrittely, koko aluksen moduulien vaihtotaajuuden selvittäminen sekä eri operaatioalueiden toiminnan kuvaamiseen käytettyjen skenaarioiden sekä systeemikartan luominen. Moduulin vaihtoaika on tutkimuksen perusteella noin yksi tunti, mutta ottaen huomioon vaihtoprosessissa mukana olevat muuttujat kuten nosturi- en sekä työntekijöiden määrän voi useamman moduulin vaihtamiseen käytettävä aika vaihdella. Maksimissaan moduulien vaihtamiseen voidaan käyttää aikaa noin kaksitoista tuntia. Suosituksi moduulien vaihtotaajuuksiksi tutkimuksessa muodostui puolen vuoden sykli, joka seuraa luonnollista vuodenaikojen vaihtelusta syntyvää operaatioalueiden muutosta. Skenaariot sekä systeemi- kartta ovat liian monimutkaisia selitettäväksi tiivistelmässä.

Opinnäytetyön arvo on siinä, että se pystyy *M2Cell* systeemistä tehdyn visuaalisen analysoinnin keinoin tuottamaan risteilyteollisuudelle käsityksen projektin kannattavuudesta niin jatkokehityksen kuin investointienkin kannalta.

Avainsanat modulaarisuus, risteilyalusten suunnittelu, systeemisuunnittelu, makromoduuli

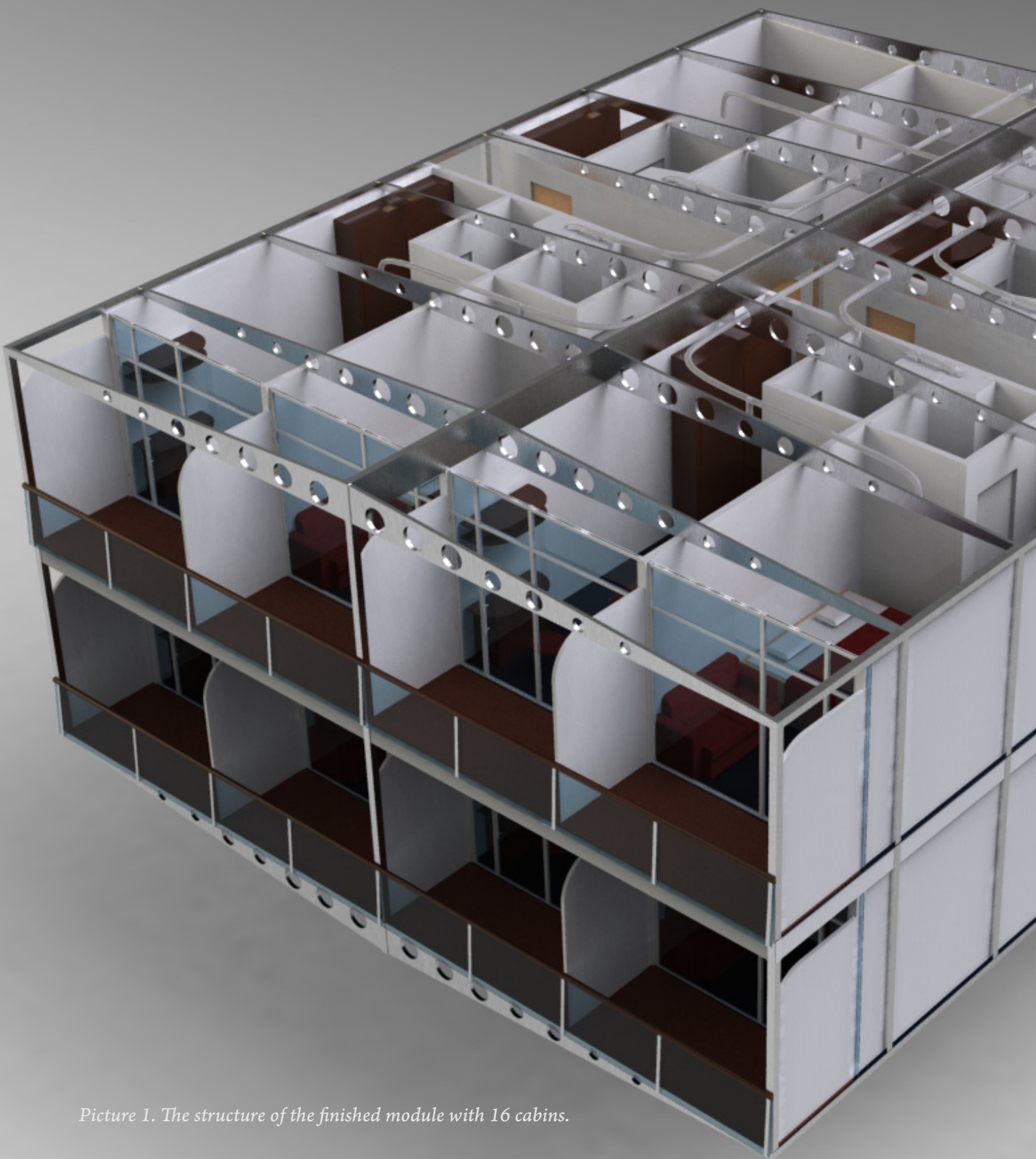


Table of Content

1 INTRODUCTION	4
1.1 Background	5
1.2 Objectives and Questions	8
1.3 Methodology	9
1.4 Partners, costs and challenges	10
2 BACKGROUND	12
2.1 History of the Cruise Culture	13
2.2 Contemporary Cruise Business	15
2.3 Division of Functions and Economy of Scale	19
2.4 Modularisation and Product Platforms	19
2.5 M2Cell	21
3 RESEARCH	24
3.1 Methodology	25
3.2 Methods	25
4 ANALYSIS	30
4.1 SWOT-analysis	31
4.2 Variables and Constants	33
4.3 Module	35
4.4 Dividing Space	36
4.5 Changing time	40
4.6 Modules and the ship	40



4.7	<i>Frequency of Change</i>	43
5	<i>SIMULATION</i>	46
5.1	<i>Module Service System</i>	47
5.2	<i>The M2Cell Fleet</i>	49
5.3	<i>Scenarios</i>	52
5.3.1	<i>Scenario 1. Bahamas and Caribbean</i>	53
5.3.2	<i>Module change between operational areas</i>	57
5.3.3	<i>Scenario 2. Scandinavia</i>	59
6	<i>DISCUSSION</i>	66
6.1	<i>Answering the research questions</i>	67
6.2	<i>Further research</i>	67
6.3	<i>Designer's role in the Triad 2012 project</i>	68
	<i>BIBLIOGRAPHY</i>	70
	<i>APPENDICES</i>	76



Picture 1. The structure of the finished module with 16 cabins.



■ CHAPTER ■

1

Introduction

Building Blocks on the Sea – Simulating realisation of M2 Cell-concept in contemporary context is a project-based thesis, which main goal is to develop further the adjustable module system called *M2 Cell* by simulating how the concept would work in the context of contemporary cruise industry. In other words, the objective of the thesis is to answer to the need for further research and ideation of the innovative system from the operational point of view. This thesis is part of the *Cruise and Ferry Experience* program's *Triad*-project, which brings together three

students from three different fields of expertise from the *Aalto University's School Of Engineering, School of Economy and School of Art, Design and Architecture*. The main objective of the project is to produce three Master's theses from three points of view covering the same topic by working in an interdisciplinary environment and having a strong collaboration, through expert interviews and guidance groups, with the real industry.

1.1 BACKGROUND

Cruise industry

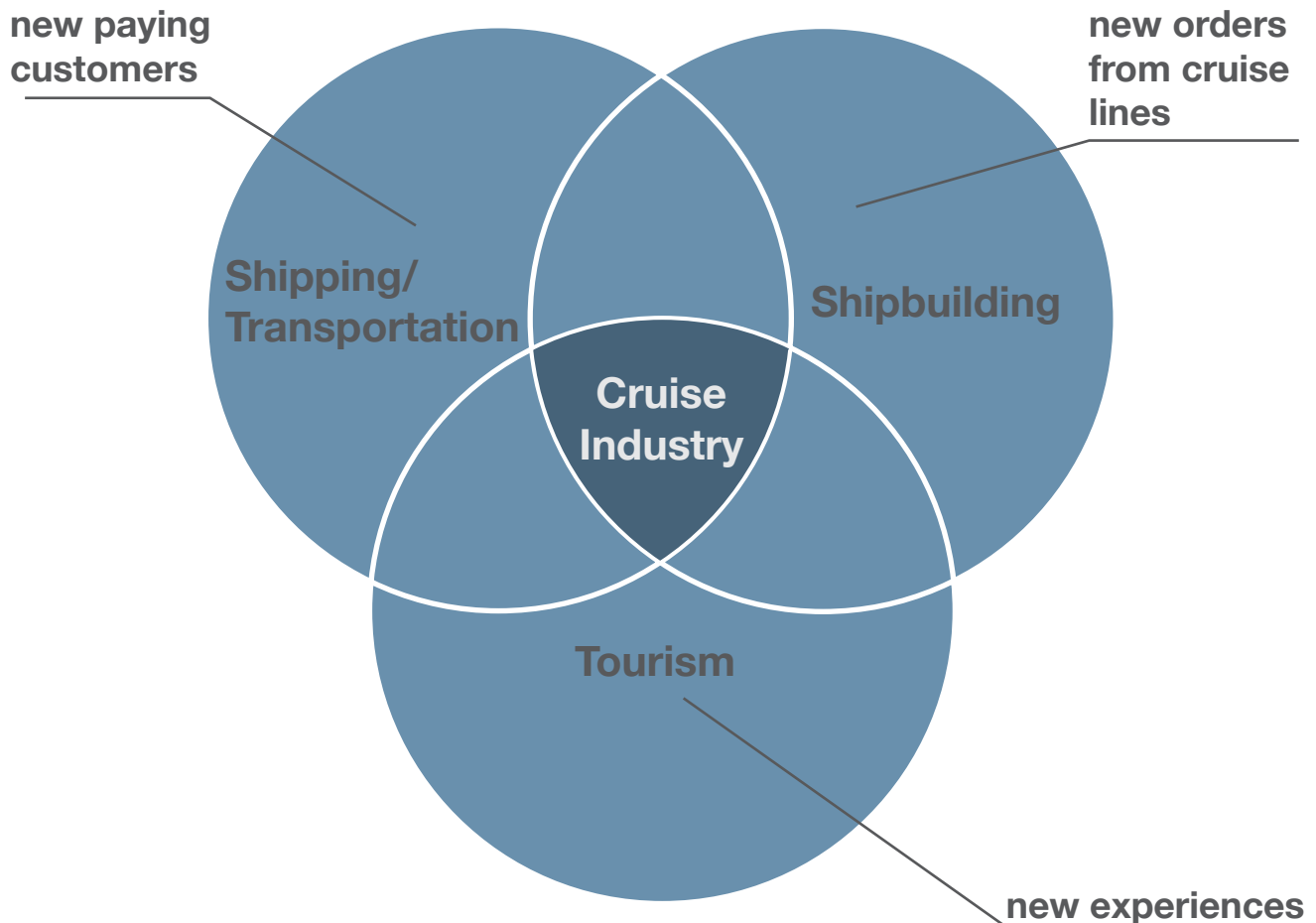
In this thesis cruise industry is seen as a merge of three areas of industries - transportation, shipbuilding and tourism. (Jantunen, O., 2011:4)

These three areas create complex chains of supply and demand, which together define the characteristics of the cruise industry (see figure 1)

Cruise ship industry as we know it today has a relatively short history starting in the 1970's in the

United States and coinciding with the establishment of *Carnival Corporation*, the biggest cruise line of today. The naissance of the mass-market and purpose-built vessels were made possible by the introduction of jet travel few decades earlier. By making the passenger liners redundant the ever-increasing air travel within and across the continents changed the very basis of sea travel in favour of the more relaxed cruising. (Quartermaine, P. et al., 2004:9 – 21)

Figure1. The three areas that define the cruise industry (Jantunen, O., 2011: 4) including writer's understanding of their wants related to cruise business.





Ever since the early days of the cruises the tendency of the ship industry has been to offer ever more services for broader variety of customers by building bigger and more luxurious vessels. (Jantunen, O., 2011:11). In 2011 there was an estimated 16 million people having a cruise (Cruise Line International Association, 2011:3), and for 2007 the *Norwegian Cruise Line* was to spend US \$1 billion on two new ships. (Quartermaine, P. et al., 2004:9) These estimations show that the industry is relatively big and the investments for keeping up with the competitors remarkable. This said it becomes clear that the cruise lines want to be certain that their investments will bring the hoped result with as little expenses as possible leading to a situation where development for cheaper manufacturing processes and overall cost-effectiveness of the vessel is appreciated and researched.

Modularisation

One of the areas in shipbuilding industry for answering to the need for improving shipbuilding performance, reducing build times and costs is modularity. (Bertram, V., 2005: 2) The main idea in modularisation is to divide shipbuilding process into smaller units that can be prefabricated prior to the installation in the main structure thus making it possible to build different parts of the ship simultaneously. According to Bertram (2005) and Erikstad (2009) there are numerous different types of modularity in shipbuilding, which are linked to

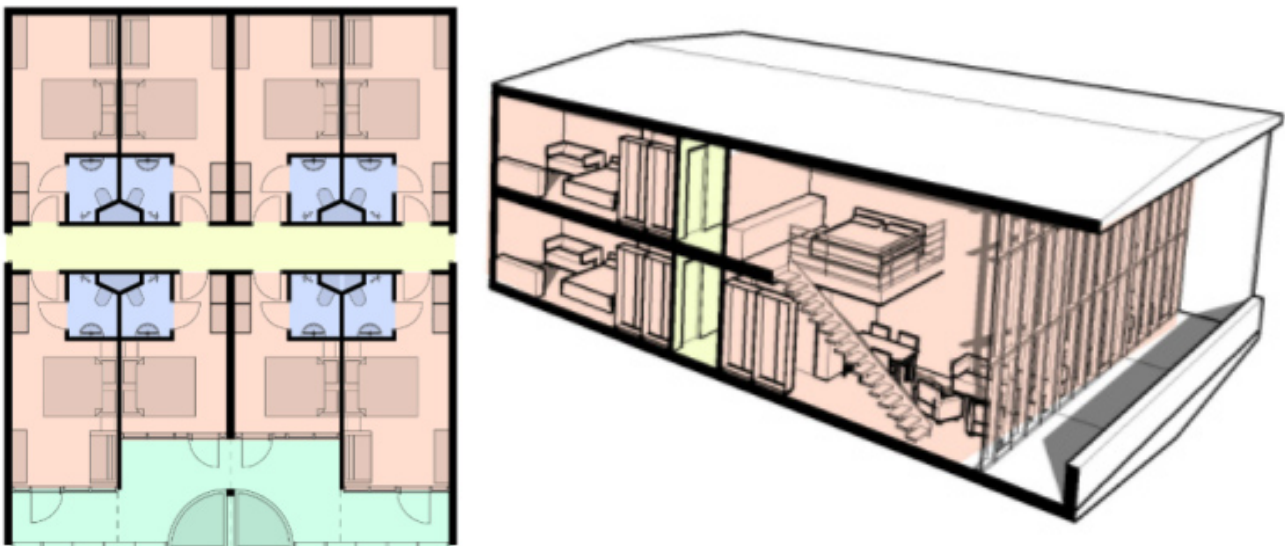
other systems concepts and technologies such as product platform technologies, product architecture, configure based design, mass customisation and lean manufacturing principles. (ibid.)

To attain a broader view of modularisation and the themes related to it a whole section of chapter 2 is reserved for the explanation .

M2 Cell

The basis for this thesis is the concept of interchangeable module system for cruise ship hotel spaces called *M2Cell* created by Antti Kauppi (2012). The main theme of the *M2Cell* concept was to develop the adaptability and easy refurbishment of cabin areas in a cruise ship by searching a systemic solution that would improve all the phases of the service life of the cabin areas from the preliminary design to decommissioning and recycling. (ibid.) The *M2Cell* concept consists of two basic sections, where the first is the skeleton of the ship including the hull and the superstructure and the second

section is the collection of interchangeable macro modules attached to the superstructure. The single macro module can accommodate maximum of 16 cabins divided in two decks (see picture 2) whereas the superstructure of the ship can hold a total of 100 individual macro modules at a time (see picture 3). The innovation of these modules compared to the contemporary modularity in shipbuilding is that the macro modules can be easily taken away and changed to another set of modules whereas the today's prefabricated cabin components are easy to install but rather difficult to modify later. (Interviewee group, 2012)



Picture 2. The macro module is divided to two decks and has a maximum of 16 cabins. (Kauppi, A., 2012)

1.2 OBJECTIVES

Objectives:

The main objective of this study is to further develop the *M2Cell* concept by bringing it closer to reality with three steps:

1. The first step is to define the contemporary context of cruise ship industry so that it would work as the surroundings for the simulation performed on the second step.
2. The second step is to simulate the realisation of the *M2Cell* concept in contemporary context, which will give insights for the industry of how the module system would work in reality and which areas of operation are still to be developed further on the step three.
3. The third step is to analyse the impact the simulation has on the design of the module and give reason for further study of the concept.

Research questions

1. What is needed for changing the modules?

This question is answered by defining the contemporary context with all the actors involved.

2. How would the system look like in operation?

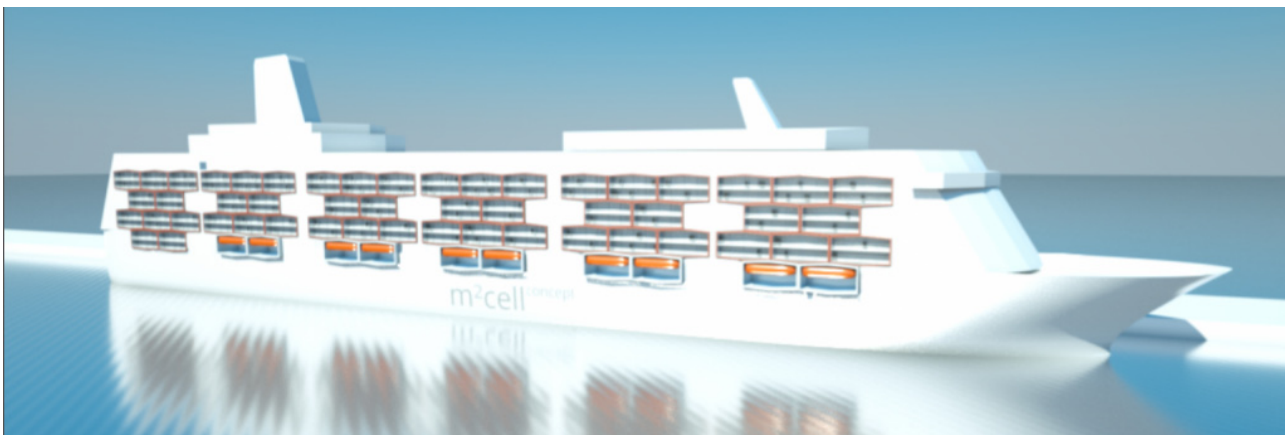
This question is answered by making the simulation, in other words, creating the model of the situation in which the system is put into operation.

3. What kind of impact does the simulation have on the structure of the module?

This question is answered by having the outcome from the previous two.

Expected results:

The result of the thesis would be the visualised simulation of realisation of the *M2Cell* concept in contemporary context and a list of the areas for further development.



Picture 3. The ship consists of a total of 100 macro modules attached to the superstructure. (Kauppi, A., 2012)



1.3 METHODOLOGY

IDEO's Deep Dive process

IDEO's deep dive process (Keinonen et al. 2004: 57) works as a structural backbone for the whole work, where the first three steps, understand, observe and interpret, are considered as the research part and the iteration circle with four steps, visualise, prototype, evaluate and specify, are considered as the basic structure for creating the simulation. Chapter 3 will be dealing with these topics related to the methodology in deeper manner.

Understand and observe:

In this part four sources of evidence are addressed, which support each other and create a strong understanding of the topic.

The first source of evidence used is archival records, which according to Yin (Yin, R. K., 2009: 105) are often computer files and records including maps, charts, service records and public use files.

The second source of evidence is ethnographic observation (or simply put ethnography), which uses participatory observation to get to know the users' physical and social surroundings. (Vuorela, S., 2005: 43). In this thesis the observations are performed on a 7-day Mediterranean cruise.

The third source of evidence is semi-structured interviews, or thematic interviews, are, according to Hirsjärvi, S. & Hurme, H., (2001) and Eriksson, P.(1986), in the middle of open interviews and questionnaires and characterised by the prefixed

theme creating a structure for the somewhat open interview. In this work professionals from different fields of expertise are interviewed to cover the structural, systemic and operational points of view. The fourth source of evidence is benchmarking, where the idea is to learn from the world leader companies how they achieved excellence and then setting out to match or even surpass it. In this case the special field of benchmarking called functional benchmarking (Dragolea, L. & Cotirlea, D., 2009) was used to discover the best functions and work processes from companies from different business sectors and areas of activity to work as a basis for the new system.

Synthesise:

In this part the collected information is analysed to give an understanding of the topic and the overall context.

(Visualize - Prototype – Evaluate – Specify) Iteration:

Making simulation prototype from the insights gathered from the interviews and observations by creating first a visual system map covering all the various actors of the system and writing scenarios from the different points of view of using the module system.

Gedenryd (1998:185) states that because our ability for intramental simulation is very limited we need material help for mental simulations. This idea



supports the usage of visualisations of the module system in operation and helps to evaluate the impact the simulation will have on the further design of the module.

Communicate and Implement:

Show the work to the collaborators and writing the Thesis.

1.4 PARTNERS, COSTS AND CHALLENGES

Partners

Aalto University School of Engineering/ Department of Applied Mechanics/ Marine Technology unit

Royal Caribbean Cruises Ltd.

STX Europe / STX Finland

Costs

The costs are covered by *Aalto University*.

Challenges

The risks in this study are related to the interdisciplinary approach, which gives new ways of seeing the project but at the same time might lead in blurring the required design perspective. Having a large variety of collaborators, who expect to receive something for exchange of knowledge and resources, might lead to a situation where the study tries to deliver something for everyone but eventually fails to please anyone. As Svensson (2003:194) puts it: Interdisciplinary work sometimes has a tendency to be shallow as it brings together people who know a

bit about many things – we should take care not to lose ourselves in the interdisciplinary process.

.



Picture 4. The author's personal interests in liners worked as a strong background for the project.



■ CHAPTER ■

2

Background

There are various factors affecting the development of the interchangeable module system for a cruise ship, and the purpose of this chapter is to introduce the ones that created the background for the project. This chapter begins with an introduction to the history of the cruise culture covering the naissence of the contemporary cruise business and the circumstances leading to that situation. The middle section of this chapter then concentrates on mentioning new manufacturing methods in shipbuilding and answering to the questions of how,

where, when and who are using the contemporary cruise services and for what purposes. In the latter part of this chapter the object of further development, the interchangeable module system for a cruise ship called *M2Cell*, is introduced. All in all, this chapter provides an understanding of the contemporary reality of the cruise business in which the *M2Cell*-concept is developed further.

2.1 HISTORY OF THE CRUISE CULTURE

Cruising, defined by Ward (2009: 12) as using passenger ship for leisure time voyages and where the ship itself and its amenities are part of the experience, has a long history dating back to the early 1800's, when the first leisure excursion was made by the wooden steamer *St Andrew* near the Scottish isles. (Robins, 2008: 8) The sailing conditions were far from the luxurious floating cities of today and this kind of operation stayed marginal for years to come

giving space for the more profitable liner vessels crossing the oceans all around the world. It must be noted that the liners transporting immigrants from one corner of the globe to another were from time to time used as cruise ships but only during the calm periods of the year.

It wasn't until the dawn of the jet age in the late 1960's with transcontinental flights making liner operation redundant that the cruise culture, as we know it today, commenced. The great change in the operation of passenger ships in the late 1960's and



Picture 5. The first modern cruise ship “Sunward” of the Norwegian Caribbean Line
(http://kelvindavies.co.uk/kelvin/details.php?image_id=6115 accessed 30.07.2012)



early 1970's can be seen as being triggered by the vast changes in the western society.

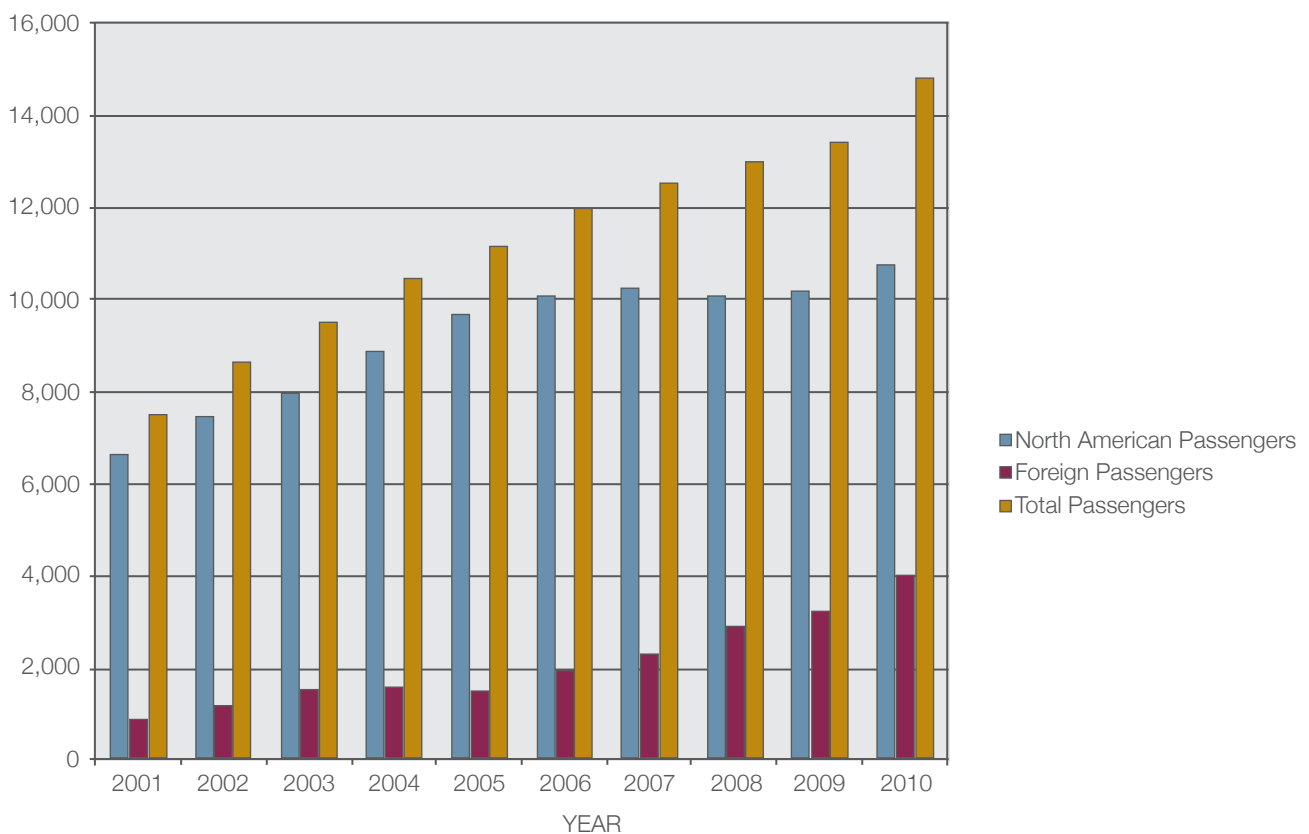
The introduction of post-modernism with its critique on the strict rules of modernist style was a way to promote the western commercialism in the time of the cold war. The popularity of shopping malls, theme parks and the whole of Las Vegas with a plurality of styles to attract a wide range of consumers was a sign of a new trend where the experience of the consumer had a stronger role.

(Dawson, P. & Peter, B., 2010; Quartermaine, P. &

Peter, B., 2006)

At the same time as the post-modern movement made their way to attract more people a peak in oil price in 1973-74 (Robins, 2008:122) wiped out almost all the old liners from the cruise business as being uneconomical to operate. This void in the cruise business created an opportunity to try out new ways of attracting a broad cross-section of the middle classes to enjoy the cruising experience. It all started on 19 December 1966 when the recently formed *Norwegian Caribbean Lines*' ship

Figure 2. The cruise passenger growth in 2001 - 2010 (Jantunen, O. , 2011)





Sunward (see picture 5) made her journey from Miami to Nassau. (Lunn, 2009:98) The positive response of her three- to four-day cruises in Bahamas caused a rapid need for new cruise ships to be built followed by formation of new rival cruise lines. (Lunn, G., 2009) During this time the biggest cruise lines of today were established such as the abovementioned *NCL* in 1966, the *Royal Caribbean Cruise Line* in 1968 and the *Carnival Cruise Line* in 1972. (Dawson, P. & Peter, B., 2010; Quartermaine, P. & Peter, B., 2006)

The new market needed new ways of attracting people such as the new ships with post-modern spaces to tempt the cruise passengers away from their familiar theme parks and hotels, and fly-cruise packages to transport them in the hub ports, but the most effective way was through television and the famous series “*Love boat*”, which with its 249 one-hour voyages introduced the romance-filled world of Caribbean cruises to the American middle class starting in 1977. (Quartermaine, P. & Peter, B., 2006:51)

As stated above the beginning of the cruise business, as we know it today, was characterised by reacting to the major changes in the western society as well as in the passenger ship industry rather than creating revolutionary innovations. This conservative evolution-rather-than-revolution attitude can be still seen as part of the cruise business partially because of the rather great investments needed to build a cruise ship.

2.2 CONTEMPORARY CRUISE BUSINESS

After the successful beginning the cruise line business has continued exceeding expectations and since 1980 the cruise line business, according to *CLIA* (2010), has witnessed an average annual passenger growth rate of 7,6% per annum. In other words this means that between 1980 and 2010 over 191 million passengers have taken a cruise, increasing number of passengers every year.(see figure 2)

According to *CLIA*(2011) the profile of an average cruise customer is that the median household income is \$ 97 000, s/he is most probably college graduate (76%), median age is 48 and s/he is married and travelling with one other person, usually the spouse (80%).

The average cruise taken in 2011 was around a week (7.4 days) and costs averaged roughly \$1790 per person for the cruise, air and all onboard expenses included. The planning for the cruise took an average of 4.9 months and the booking took place within 3.3 months before the beginning of the journey.

The most appealing place to cruise was Caribbean (45%) followed by Alaska (24%), Bahamas (23%), Hawaii (15%), Bermuda (15%) and Mediterranean/ Greek Islands/Turkey (14%) (*CLIA* 2011), which is very similar to the real cruise area distribution by

Figure 3. Cruise area distribution by passenger capacity in 2008 (Jantunen, O., 2011)

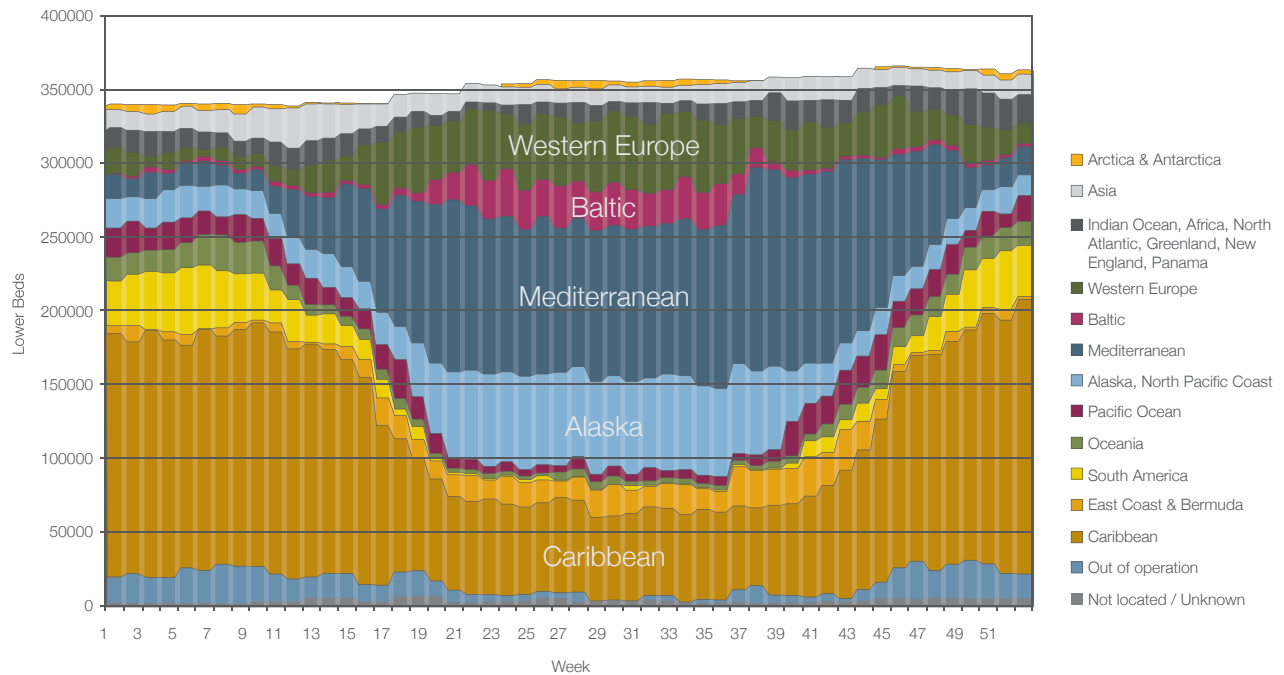


Figure 4. Estimated share of passengers per cruise company in 2012 (<http://www.cruisemarketwatch.com/market-share/> accessed 15.02.2012)

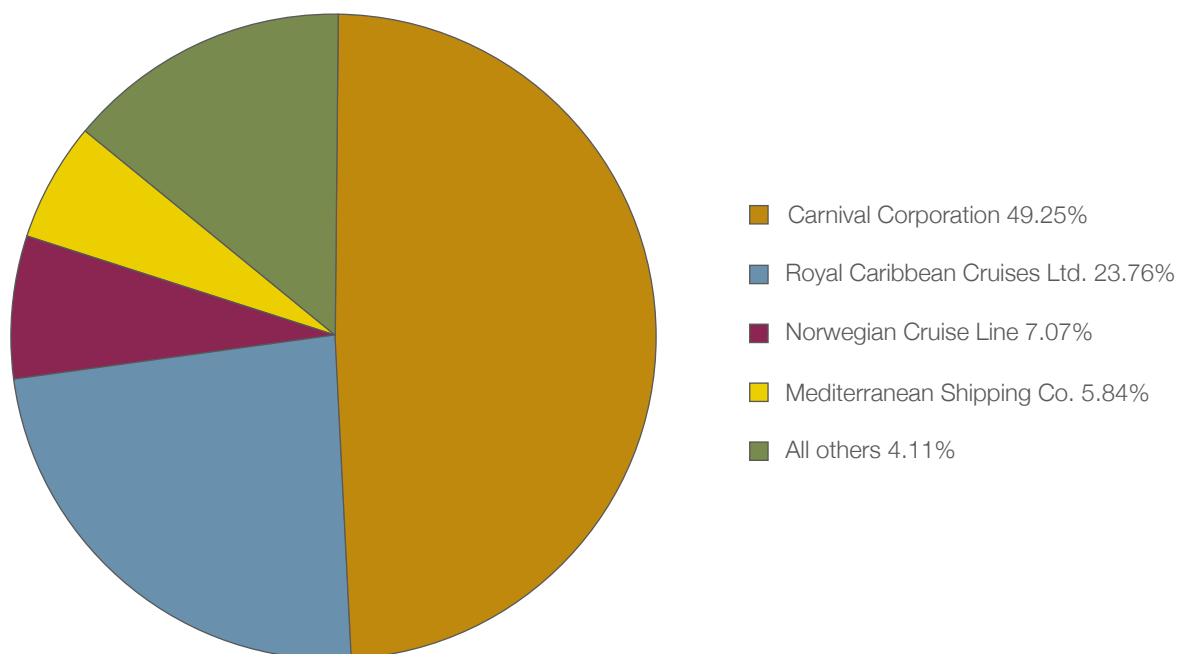




Figure 5. Positioning of the cruise lines according to some key features. (Soinila, J., 2011: 5)



passenger capacity in 2008 (see figure 3) (Jantunen, 2008)

When asked about the benefits of cruising compared to other vacations the top choices included: chance to visit several different locations (56%), being pampered (44%), fine dining (51%), and getting away from it all (44%) (CLIA, 2011).

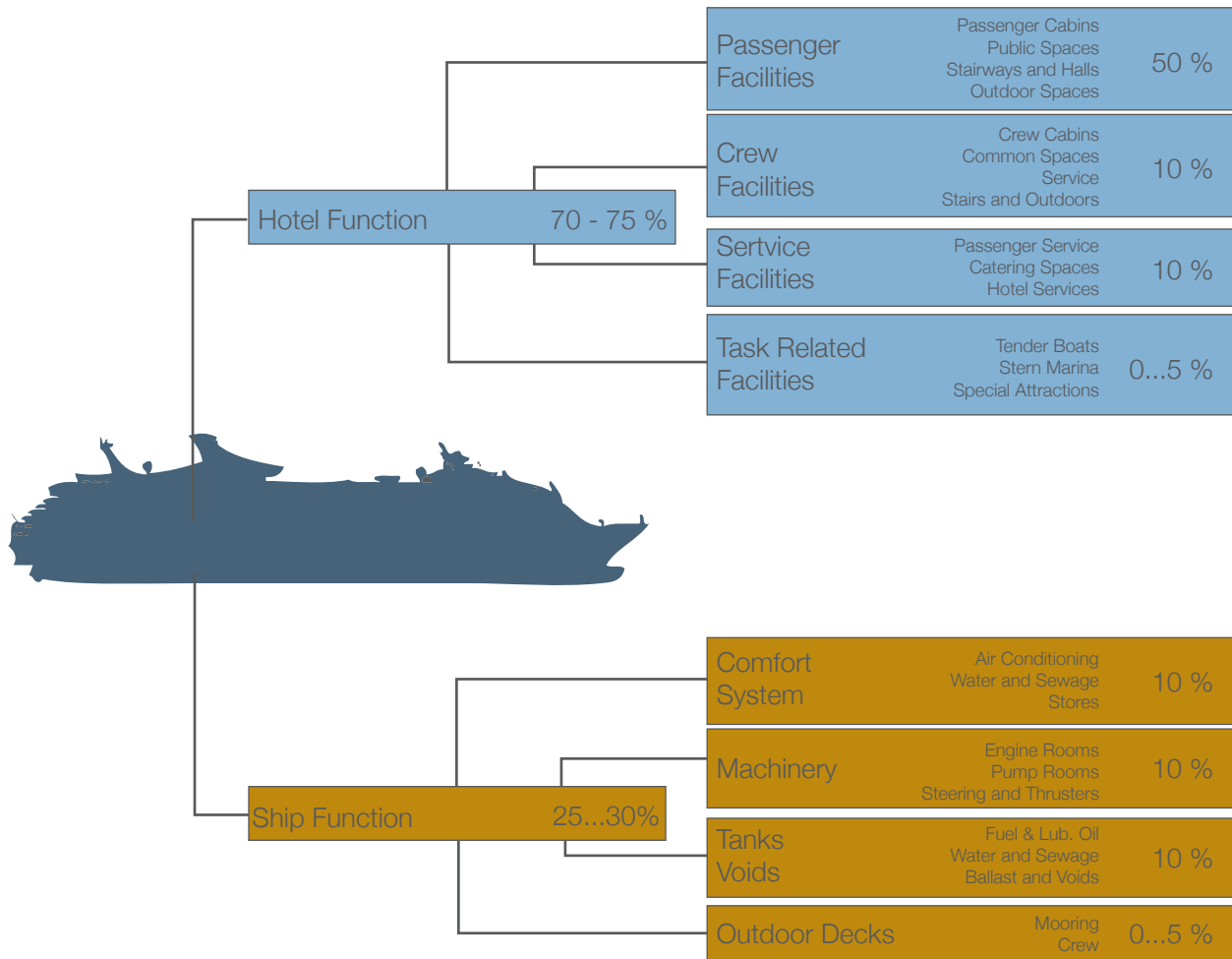
The estimated share of worldwide passengers for 2012 according to cruise market watch (2012) was divided so that *Carnival Corporation & plc.* has 49.2% of the grand total followed by *Royal Caribbean Cruises*

Ltd. with 23,73% and *Norwegian Cruise line* 7.07%, (see figure 4) which is very similar to the market share situation in 2011 when *Carnival corporation* had 50% of the whole market, *RCCL* 33% and *NCL* 10%.

It is important to bear in mind that the *Carnival Corporation & plc* is a collection of different cruise lines including *Carnival Cruise Lines*, *Holland America Line*, *Princess Cruises* and *Seabourn* in North America; *P&O Cruises* and *Cunard Line* in the United Kingdom; *AIDA* in Germany; *Costa Cruises* in



Figure 6. Division of functions in a stereotypical cruise ship. (Jantunen, O., 2011)



Southern Europe; *Iberocruceros* in Spain; and *P&O Cruises* in Australia. (Carnival Corporation)

Similarly the *Royal Caribbean Cruises Ltd.* operates several different cruise lines including the *Royal Caribbean International*, *Celebrity Cruises*, *Pullmantur*, *Azamara Club Cruises* and *CDF Croisieres de France* brands, and *TUI Cruises* through a 50% joint venture. (Royal Caribbean Cruises Ltd.)

The position in the industry of the different cruise lines is visualised by Soinila (2011) in his

presentation, where he explains the situation from the *Royal Caribbean Cruises'* point of view. (see figure 5) In this figure it is interesting to see that the industry can be divided into four different categories according to the price and level of formality onboard.

2.3 DIVISION OF FUNCTIONS AND ECONOMY OF SCALE

The average cruise ship can be divided into two function areas, where the hotel function is using 70-75% of the space and the ship function 25-30% of the space. (Jantunen, O., 2011) The subsystems in the hotel function category according to Jantunen (ibid.) can be divided into four sections where the passenger facilities are taking half of the whole space in the ship (see figure 6).

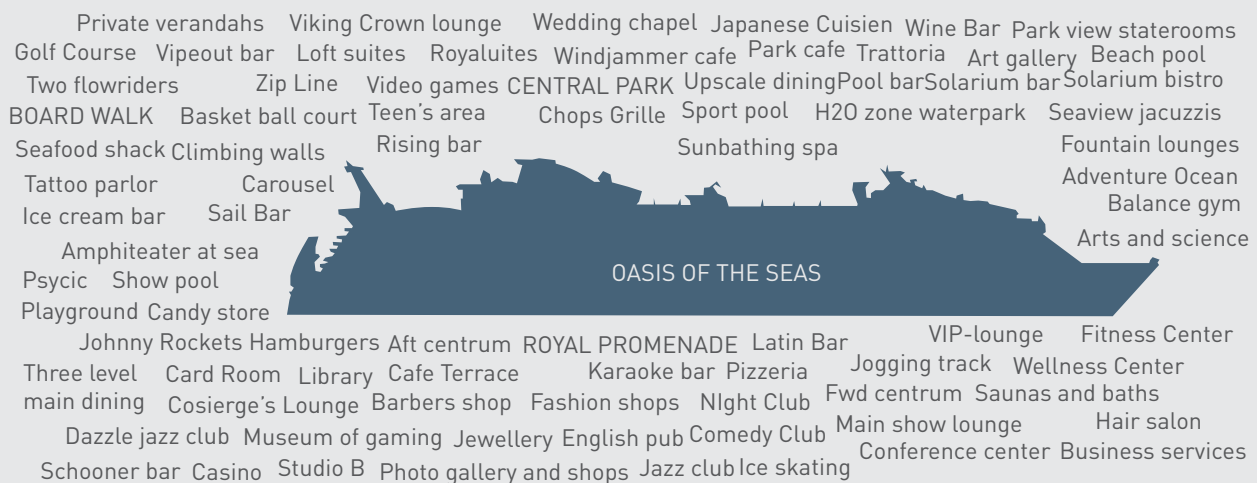
By increasing the size of the vessel it is possible to offer more services for more people – economy of scale. (see figure 7)

2.4 MODULARISATION AND PRODUCT PLATFORMS

One of the areas in shipbuilding industry for answering to the need for improving shipbuilding performance, reducing build times and costs is modularity. (Bertram, V., 2005: 2) Studies conducted by the *U.S. Navy* show that there is achievable reduction in construction costs of 5-10% by implementation of modularity in Navy combatant design and construction. (Shawna, N. & Edyvane, J., 2010:1)

Figure 7. The service offering onboard the *Song of Norway* and the *Oasis of the Seas*. (Jantunen, O., 2011)

BOTH SHIPS HAVE EQUAL VOLUME PER PASSENGER (ca.120 m³/p)





Modularity and modularisation as terms are widely used in various fields of study but the commonalities, according to Erikstand (2009: 5), are:

1. The division of a larger system into smaller parts or components
2. The principle of (relative) self-sufficiency of the individual parts
3. The recombination of the parts into multiple end products, according to a set of “rules” given by an overall systems architecture

In shipbuilding the idea of modularity is still characterised by the definition given by Jollif (1974: 11-32):

“Pre-packaging a collection of equipment (systems or components) for the purpose of their assembly and check-out prior to delivery to the ship for installation and for ease of installation and removal of the package (module)”

The general objectives of this kind of practice, according to Bertram (2005: 2-3) are:

- reduced design and construction cost
- reduced design and construction time
- greater flexibility for updates later in the ship's life (temporary for missions or general update)
- shorter and cheaper maintenance periods
- reduced maintenance cost

On the other hand he reminds of the disadvantages encountered, such as:

- higher initial design effort
- reduced design freedom (possibly retarding technological progress)
- usually higher weight
- usually increased space requirements

Another term related to modularity and modularisation is product platform, which according to Erikstad (2009: 6) means:

“a structured, coherent collection of resources, including systems and template hierarchies, textual components, variants, rules and interface definitions, from which a range of customized product definitions can be derived”

In this context the modularisations can be seen as the building blocks from which the product platform is eventually build. (ibid.)

Modularisations being strongly related to product platforms the objectives and disadvantages of the former can be thought to include the latter as well.

The primary tradeoff of the product platform design process including the modularisation is between commonality and distinctiveness (Simpson, T. W., 2003), or between cost-cutting and increasing market shares (Ericsson, A. & Erixon, G., 1999).

2.5 M2 CELL

As stated already in the introduction chapter the basis for this thesis is the concept of interchangeable module system for cruise ship hotel spaces called *M2Cell* created by Antti Kauppi (2012). In his thesis the main theme was to develop the adaptability and easy refurbishment of cabin areas in a cruise ship by searching for a systemic solution that would improve all the phases of the service life of the cabin areas from the preliminary design to decommissioning and recycling. (ibid.)

Despite the promising words the concept is left on an early stage, introducing a new idea of interchangeable modules in a specially built cruise ship, thus allowing further research to be concentrated on how the system would work in reality.

His main work, the cabin areas, culminates in introduction of three different spatial arrangements for different cultural preferences – the loft (see pictures 4 and 5), the cabins with *Jacuzzis* (see picture 1) and the promenade with indoor cabins and shops (see picture 2). The style of the arrangements is intentionally very clean, white and without any noticeable decorative features to underline the division of the space itself and not the interior design.

Because Kauppi's thesis was finished three and half months after the further research for the project had started some of the ideas and research areas in his finalised thesis are interlaced with the ones introduced in this thesis.

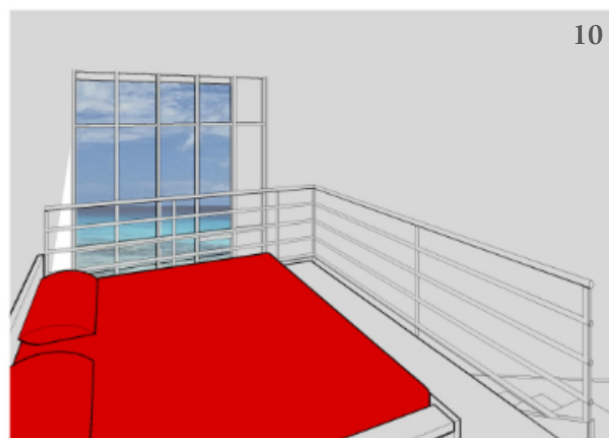
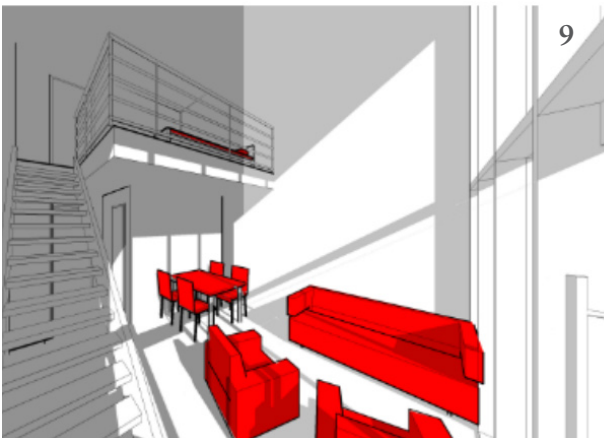
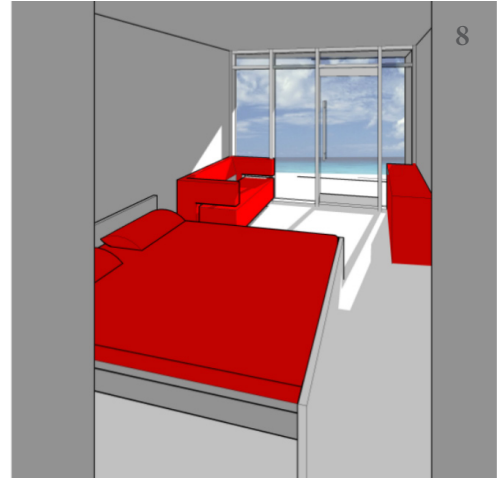
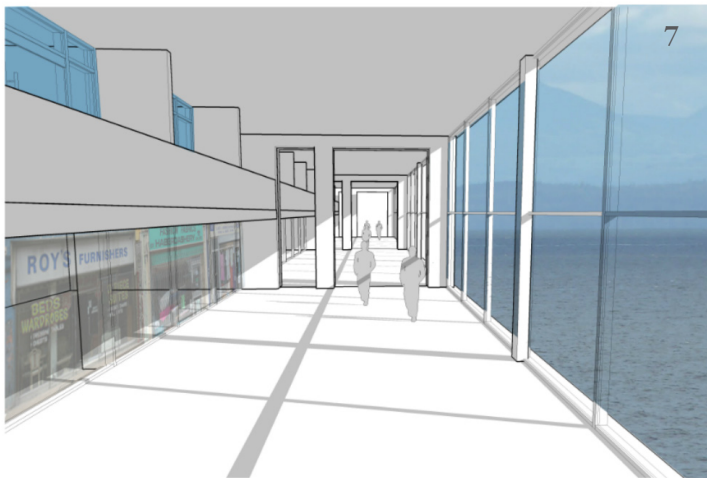
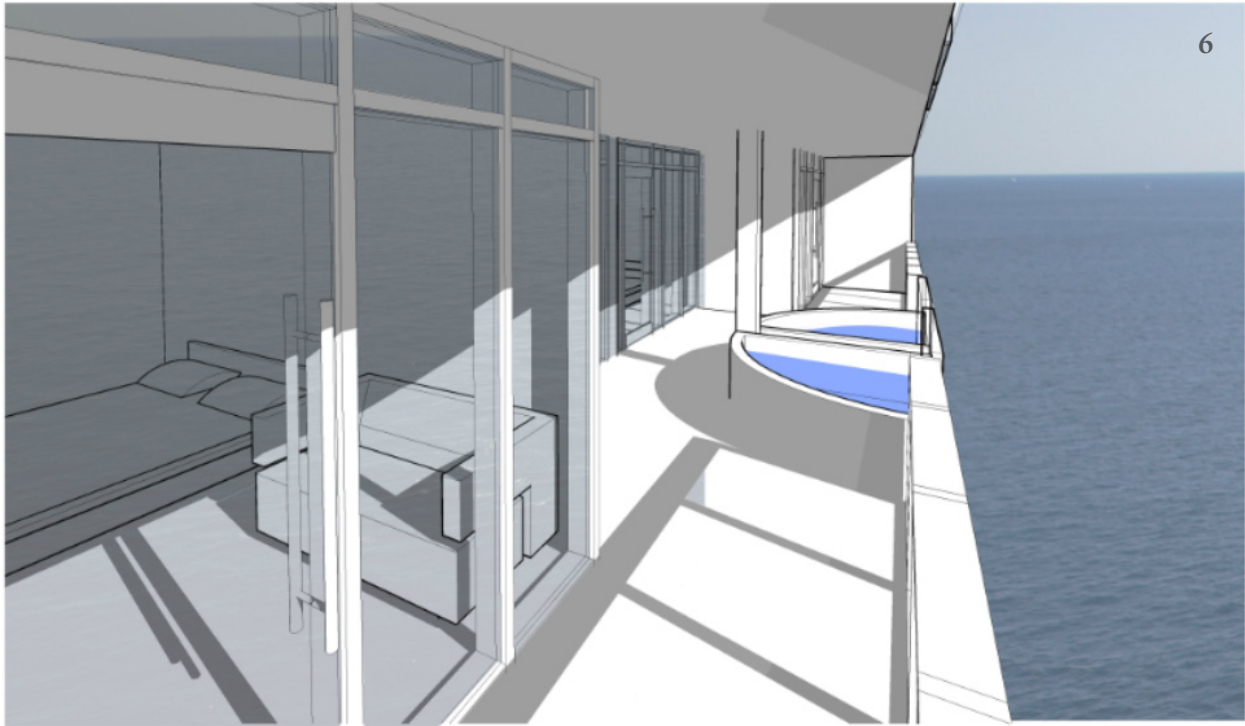
*Picture 6. Balcony area with private jacuzzis.
(Kauppi, A., 2012)*

Picture 7. Promenade. (Kauppi, A., 2012)

Picture 8. Normal cabin. (Kauppi, A., 2012)

Picture 9. Loft cabin. (Kauppi, A., 2012)

*Picture 10. Inside balcony in loft cabin.
(Kauppi, A., 2012)*





Picture 11. Some of the research was done onboard a cruise ship. In this picture is the port in Tunis.



■ CHAPTER ■

3

Research

In this chapter the methodology of the research is explained by introducing the research methods and tools that were used to gain information. Throughout the chapter these tools are evaluated and the purpose for their use in the research is explained.

The chapter begins with introduction to the big picture of the study and continues by concentrating on each individual method creating the fore-mentioned entity. The purpose of this chapter is to lead way for the next Analysis and Simulation chapters that use the information gained through the research made

by the tools introduced in this chapter.



3.1 METHODOLOGY

The purpose of this thesis is to further develop the *M2Cell* concept, and to do so the work is divided into two parts – research and simulation. The former part defines the contemporary context of a cruise industry by looking into the phenomena related to cruising, modularity and design, and the latter part uses the gained knowledge and by creating scenarios tries to simulate the possible utilisation of the adjustable module system.

IDEO's deep dive process (Keinonen et al. 2004; Moen 2001) was chosen to work as a structural backbone for the whole work, where the first three steps, understand, observe and interpret, are considered as the research part and the iteration circle with four steps, visualise, model, evaluate and specify, are considered as the basic structure for creating the simulation. (see figure 8)

In the *IDEO's* process a very crucial part is a “*Hot Project Team*”, a group of passionate people with interdisciplinary background and a clear goal, which all matches with the *Triad* team. (Moen 2001) This said it was clear that the process could work in this project.

3.2 METHODS

The first and the second step – understand and observe

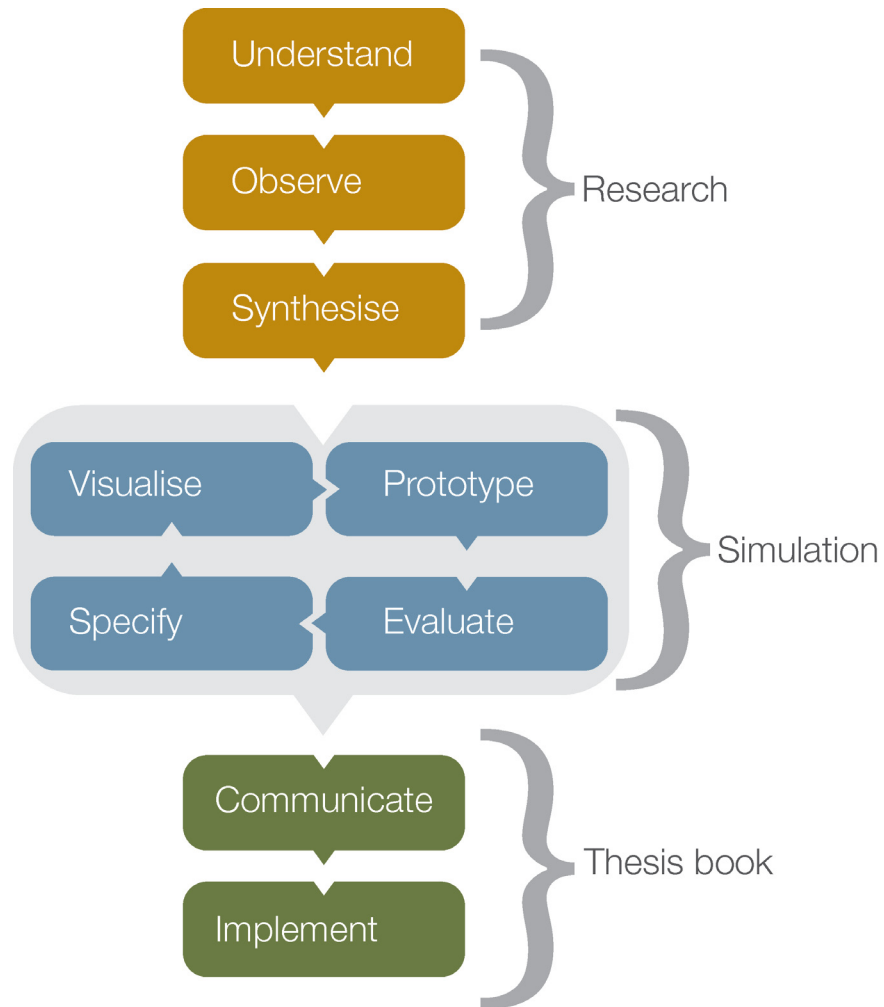
In this part 4 sources of evidence are addressed. The data collection methods used are described, such as how, where, when and what information is needed

for the study. The strengths and weaknesses of each source of evidence are discussed following the analysis on how this information is collected in this particular study. Both qualitative and quantitative methods were used although the latter is analysed only as a descriptive statistic for the background study of the project. According to Hirsjärvi et al. (2001) in some cases using numerous research methods leads to more trustworthy results provided that the chosen methods support each other. The main goal for the first two steps of the process was, as Moen states (2001), to understand the market, the client, the technology, and the perceived constraints on the project.

As mentioned already in the introduction chapter, the first method used was archival records, which according to Yin (Yin, R. K., 2009:105) are often computer files and records including maps, charts, service records and public use files.

The second method used was ethnographic observation (or ethnography). This method uses participatory observation to get to know the users' physical and social surroundings. In the field research phase the researcher tries to understand the users from their point of view the best way possible by observing the environment and actions as well as interviewing and having conversations with them. (Vuorela, S., 2005) Ethnographic observation allows the researcher to express his own notions during the time of the observation and not just repeat the issues covered by the interviewee (Vuorela

Figure 8. The IDEO's deep dive process divided in research and simulation parts



S.,2005), which gives freedom to better understand the user but at the same time might lead to some misunderstandings. Another challenge with observations is the unique nature of the situation, where it is used; there is no possibility to return to the situation later and try to re-observe it. The third method used was semi-structured interviews. This method is included as part of the other methods but was from time to time used as an individual method for collecting data. Semi-structured, or thematic interviews, are, according to

(Hirsjärvi, S. & Hurme, H., 2001) and (Eriksson, P., 1986), in the middle of open interviews and questionnaires and characterised by the prefixed theme creating a structure for the somewhat open interview.

The strengths of this method are, according to Vuorela (Vuorela, S., 2005), flexibility with the questions asked and the direct communication with the interviewee, which makes it possible to change or develop the questions *in situ*. (Hirsjärvi et al., 1997). The challenges with this method are linked to the

creation of the correct questions and the talent of the interviewer to activate and steer the conversation to make best out of it without leading the interviewee and manipulating his answers.

The fourth method used was benchmarking. The idea of benchmarking is to learn from the world leader companies how they achieved excellence and then setting out to match or even surpass it. The special field of benchmarking that was used in this thesis is called *Functional benchmarking* (Dragolea, L. & Cotirlea, D., 2009), where main purpose for the companies is to “*improve their processes or activities by benchmarking with other companies from different business sectors or areas of activity but involved in similar functions or work processes*”. The functional benchmarking will concentrate on a single function that needs to be improved, or in this case created, and tries to discover the best practices for this function in question. Benchmarking has several ways to be conducted from which interviewing is one.

The strengths with this method are that it suits very well for the situation where one already has a concept of a system and needs to search for the best ways to use it. The challenge is to find the correct information and use it so that it supports the concept and improves it, not copying someone else's concept and replacing it without consideration. (Dragolea, L. & Cotirlea, D., 2009)

The third step – synthesize

In this part the data analysis is introduced. In the IDEO's process this would mean that all the information collected in the first two research part would be grouped together and put on walls of a project room. This was done by putting insights in post-it notes and diagrams on walls. Only one analysis, the SWOT analysis describing the strengths, weaknesses, opportunities and threats of the concept, was done together with all the group members and all the other parts were done individually due to the differences in timetables. The individual way of synthesizing the research can be seen as not following the rules of the deep dive process, especially the idea of teams being the heart of the project, and might lead to narrow conclusions of the research. On the other hand the team had later on open conversations about each other's work, which helped to prevent being too focused on one idea.

From fourth till seventh step: The iteration circle - visualise, model, evaluate and specify

The idea of this section is to create as many visualisations and prototypes as possible, evaluate them and develop them further so that from all the failures made during this section something is learned and taken further. (Moen, R., 2001)

This part consists of making simulation prototypes from the insights gathered during the interviews and



observations by creating first a visual system map covering all the various actors of the system then drawing a diagram of the journey of the change and finally writing scenarios from the different points of view of using the module system.

Gedenryd (1998:177) explains the usage of scenarios in system development by saying that:

“Using scenarios in system development helps keep the future use of the envisioned system in view as the system is designed and implemented; it makes use concrete – which makes it easier to discuss and to design use.”

He then continues describing how a scenario and a simulation are linked to each other by stating that:

“It (scenario) merely provides the script, it must somehow be dramatized to come alive, to re-create the flow of time and events in a genuine situation. The simplest form of doing this is by simulation, where the designer is re-creating – simulating – the future events by herself” (Gedenryd, H., 1998:185)

In his opinion when the situation that should be re-created is complex enough physical material should be employed as support. In other words he suggests that our ability for intramental simulation is very limited. (ibid.) This idea of needing material help for mental simulation supports the usage of

visualisations of the module system in operation and helps to evaluate the impact the simulation will have on the further design of the module.

In the Simulation chapter of this thesis only the last simulation of the module system is presented with system map, diagram of the change journey and scenarios.

Kauppi työ keskittyy
vain hyttysalaisiin
ja niiden remontointiin.
Moduulien monipuoli-
sempi käyttö on minun
aiheeni.

Picture 12. Many of the author's thoughts were written on post-its to structure the thinking process.

"Kauppi's thesis concentrates only on the cabin areas and their renovation. My thesis is about diverse ways to use the modules."



■ CHAPTER ■

4

Analysis

In this chapter the various pieces of information received from the research is put together and analysed to create the basis for the final scenario building and simulation. The topics in this chapter are related to the shape, size, space division and changing time of the module as well as to the analysis of the extra value in the whole service system.

In the beginning of this chapter a *SWOT*-analysis is introduced, which shows the strengths, weaknesses, opportunities and threats related to the interchangeable module system. The latter part of the chapter

deals with the actual shape of the module and the changing process creating the basis for the extra value of the innovation.



4.1 SWOT-ANALYSIS

To understand the positive and negative aspects of the concept a *SWOT*-analysis (see figure 9) was created out of the information gathered from Kauppi's (2012) thesis. This analysis, as mentioned earlier, was the only one made as a group with the whole *Triad* team. The biggest strengths of the concept were the adaptability and customisation of the vessel and added customer value due to the possibility of customisation. The first-mentioned strength will be further examined in later sections of this chapter, where the variables provided by the adaptability and customisation are introduced.

The biggest weaknesses are technical issues that are not yet examined/designed, the big size of the module that makes it difficult to move long distances needing special cranes even for lifting, and special issues related to the costs of constructing the modules.

In this thesis the size of the module is questioned, other potential forms examined and division of space analysed to define better whether or not the construction and size of the module can be still regarded a weakness.

When speaking about the opportunities the biggest topics that were found were the new target markets, competitiveness and new logistics system. From these ones the latter on is observed better in the

simulation chapter, where an improved system map and change structure break down diagram are introduced explaining the actors involved in the module system including step-by-step operations. Similarly the threats including warehousing costs, complex order system and safety regulations are relatively close to the opportunities and thus are included in the simulation chapter as part of the system map and change structure break down diagram.

Generally speaking the whole *SWOT*-analysis diagram was used as a guide in the creation of the simulation and many of the negative aspects that were seen as challenges were developed bringing more extra value to the system than using resources. As seen later, for example, for the warehousing costs a solution was proposed – a module company that could handle hundreds of modules for various shipping companies thus reducing the warehousing time.

Moreover the positive aspects of the *SWOT*-analysis diagram were brought forward so that their impact on the operation of the module system is clear in the simulation. The best example is the visualised scenario of one of the *M2Cell* cruise ship's journey in two different operational areas, where the positive impact of the adaptability is playing a strong role.



Figure 9. The SWOT-analysis shows the positioning of the innovation according to the internal and external pros and cons.





4.2 VARIABLES AND CONSTANTS

Changing the way the cruise ship industry works by introducing a new innovation will have various impacts on the whole service system. By recognising the areas, where the changes might happen, and taking into account the probable variables and constants brought by the new innovation it is possible to create scenarios that reflect the new reality of the cruise industry. In other words finding the most probable ways of using the new *M2Cell* concept from endless possibilities brought by the adjustability allows us to see how the whole system with various services would change if the innovation was in use.

Throughout the whole design process a list of positive and negative aspects of the *M2Cell*-concept were gathered, from which a *SWOT*-analysis was made. The analysis works as a good reminder of the extra value the concept has to offer.

When dealing with the module as the main object in question, the variables and constants need to be divided into two sections, interior and exterior. The interior section consists of all the things related to the inner reality of the module whereas the exterior section deals with factors surrounding it. (see figure 10)

Looking at the situation in the contemporary cruise industry from the ship's point of view, it is clear that there are many things that stay the same for a long period of time. These constants are for example the

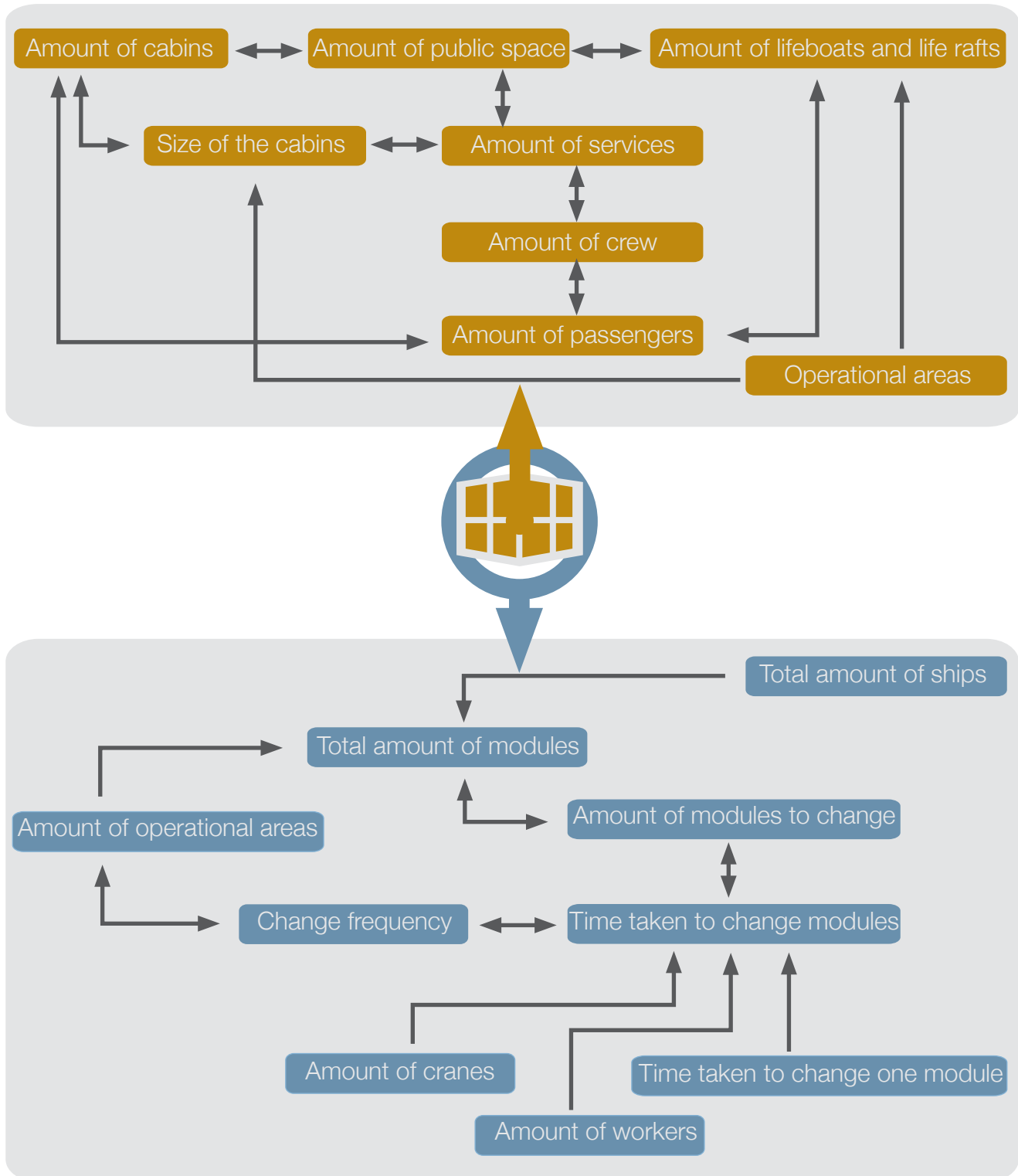
structure of the ship, including cabin shapes and sizes, public areas and their design, the maximum amount of passengers and crew, and the amount of lifeboats and life rafts. These areas stay the same for a long period of time, because of the large amount of expenses and the relatively long time taken to change them. (Interviewee group, 2012) (see appendix D)

The variables on the other hand are more to do with things such as services provided onboard, the operational areas, the demographic of the passengers and crew and in some cases with the accepted currency and the official languages spoken onboard. Most of these variables are immaterial and reflect the idea that the ship remains unchanged although the operational areas change.

When introducing the modular interchangeability and adjustability brought by the *M2Cell* concept, the ratio between the constants and the variables shift including more areas on the latter part. Because of the interchangeable nature of the modules the ship's structure is divided into two areas, where the hull and the superstructure stay constant and the modular sides vary depending on the interiors of the modules.

To avoid the idea of chaos, when talking about the increase in number of variables, it must be stated that all the variables are interdependent and thus create a net of relationships between each other.

Figure 10. Internal variables of the module on top and external variables on bottom. Grey lines indicate the causality between two variables.



4.3 MODULE

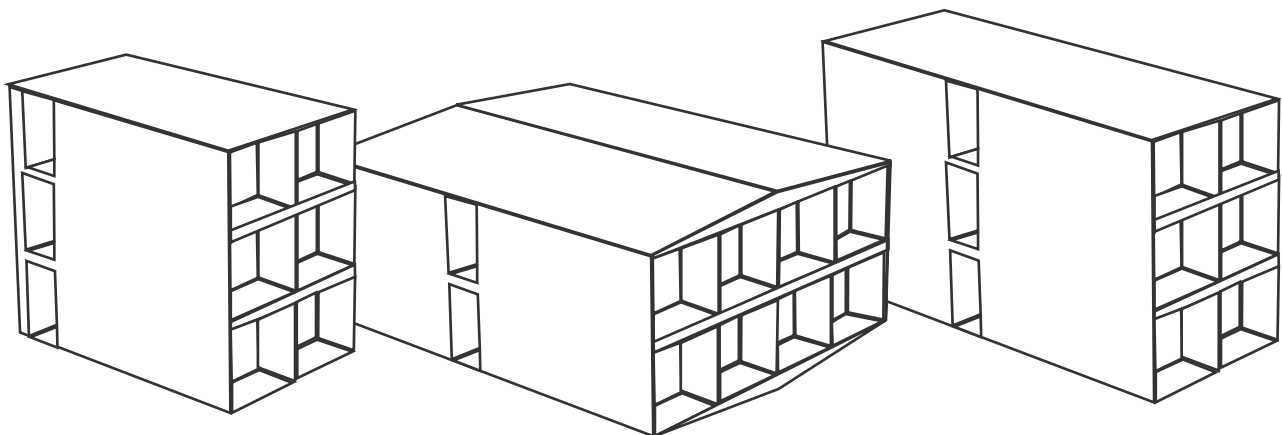
In his thesis Antti Kauppi introduced the *M2 Cell* modules as hexagon shaped pieces, which are pushed and pulled out of the side of the ship, without further explaining the construction of the ship or giving a reason for the horizontal way to change the modules. Understandably the module system in question was developed to a very early stage of the design process and he even mentions in the latter part of his thesis that there is a need for further research in different areas of the concept. (Kauppi, A., 2012: 70)

The first challenge was to question the shape and the size of the module, which was done during the expert interviews. In some cases the interviews ended up being more like co-design sessions, where the interviewee and the interviewer were both together finding new solutions for the module's size and shape and the way they are installed and taken away. (Interviewee 2., 2012) (see picture 13) Eventually

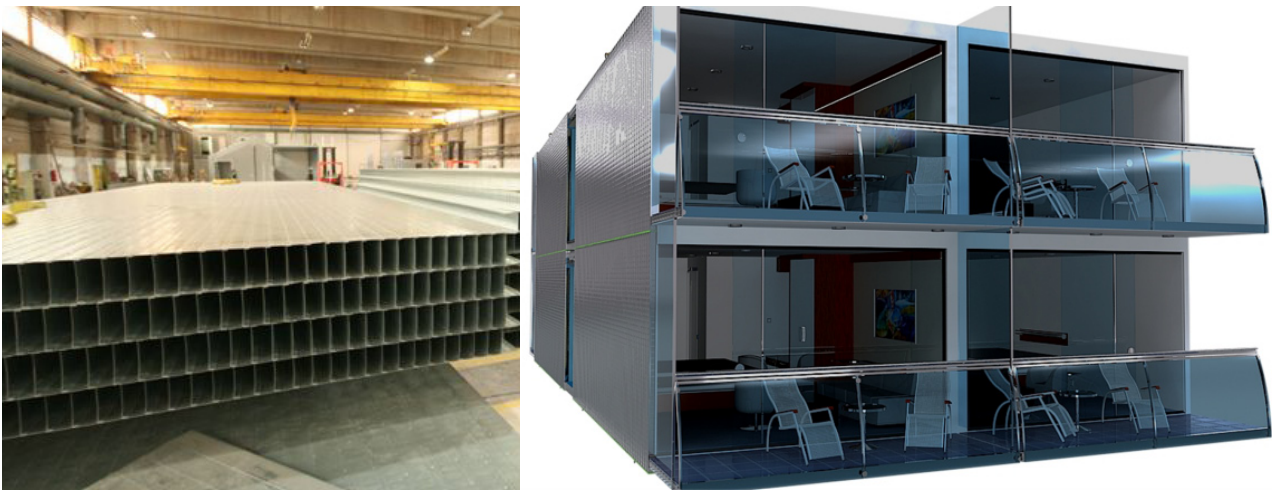
after few interviews with people from different fields of expertise the shape and size were fixed to the one designed by Kauppi. The reason for this was that the macro module was thought to be big enough for different interior solutions and yet light enough to be changed in relatively short amount of time. (Interviewee group, 2012) (see appendix D)

The fixed version of the module weighs around 60 tonnes (Interviewee 2., 2012) (see appendix B) and the exterior dimensions are 12.2 m wide, 14.63 m deep and 6.4 m tall, but the triangular top and bottom areas reduce the interior height to 5.4 m. (Kauppi, 2012) According to Kauppi this size is equal to 5 standardized 48feet containers thus giving the possibility of transporting the macro modules in container ships.

The main structure of the module, according to the interviews, can be done in various ways depending on the company behind the process. (Interviewee



Picture 13. Three different shape and size modules were evaluated and introduced during the interviews. The middle one was thought to be the best.



Picture 14. The construction of a modular cabin unit made out of the hot-galvanised steel profiles (Pictures by Shippax)

2., 2012; Interviewee 3., 2012) (see appendices B and C) The company making prefabricated cabin modules for ships suggested a steel sandwich structure made by joining hot-galvanised steel profiles together so that the structure itself would be rigid but at the same time the whole weight of the module would stay light enough. (see picture 14) On the other hand the company renting containers, or customised spatial units as they call them, for construction sites, schools and other facilities suggested that the structure of the *M2Cell* module could be similar to their customised modules. In their opinion a steel frame with standardised modular wall construction has been a good solution for their needs. (see picture 15)

For this thesis a mixture of these two suggestions was made so that in the macro module a rigid steel frame is introduced with modular steel sandwich structure walls. The outer frame will carry the external payload

while the walls inside are responsible for the internal stability. (see pictures 16 and 17) In this way the interior can be easily divided into two decks in various ways without compromising the structural safety.

4.4 DIVIDING SPACE

As Antti Kauppi has already shown in his thesis that the macro module's interior can be divided in various ways to different kinds of cabin solutions. Continuing this kind of idea of spatial division and taking into account the public areas in a ship that can be allocated inside a module it becomes clear that there are thousands of possible ways to construct ship's whole interior with the macro modules. In case of almost endless solutions it is not reasonable to start to name out all the various division possibilities but merely discover the constraints and main characteristics the options have. (see figures 11 and 12)

In this case the maximum dimensions for a space are

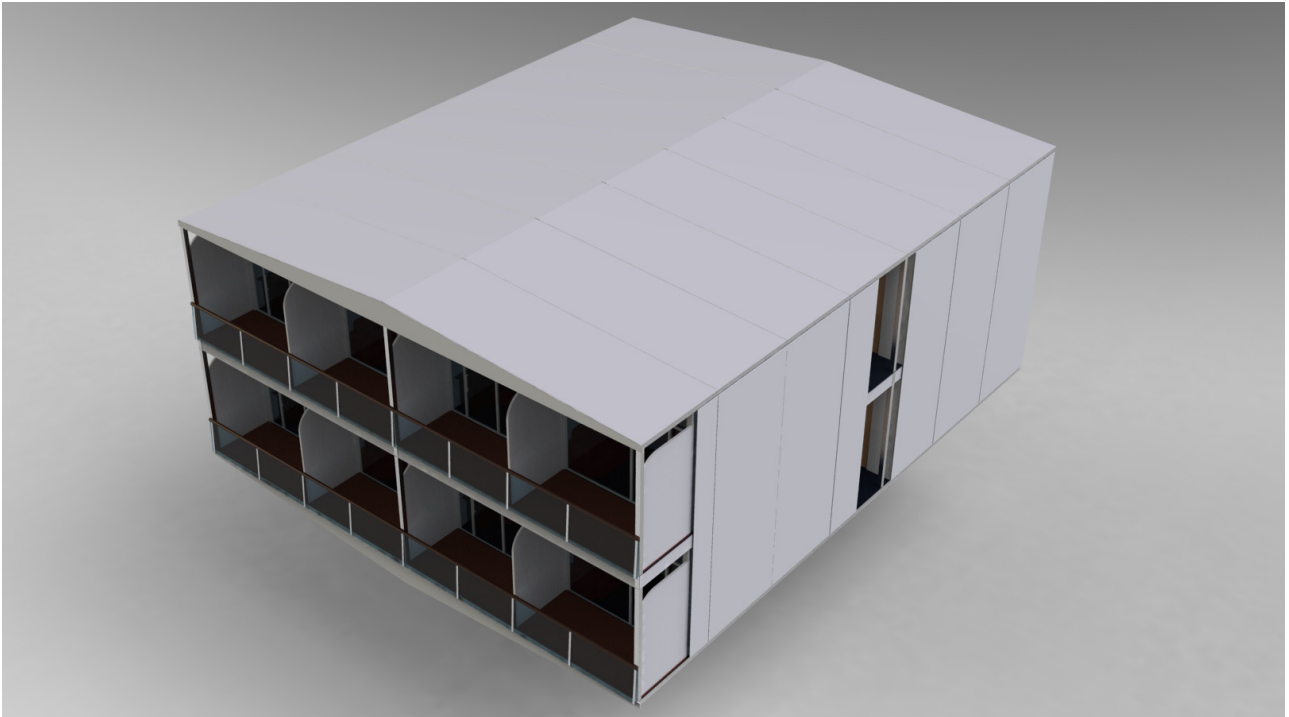
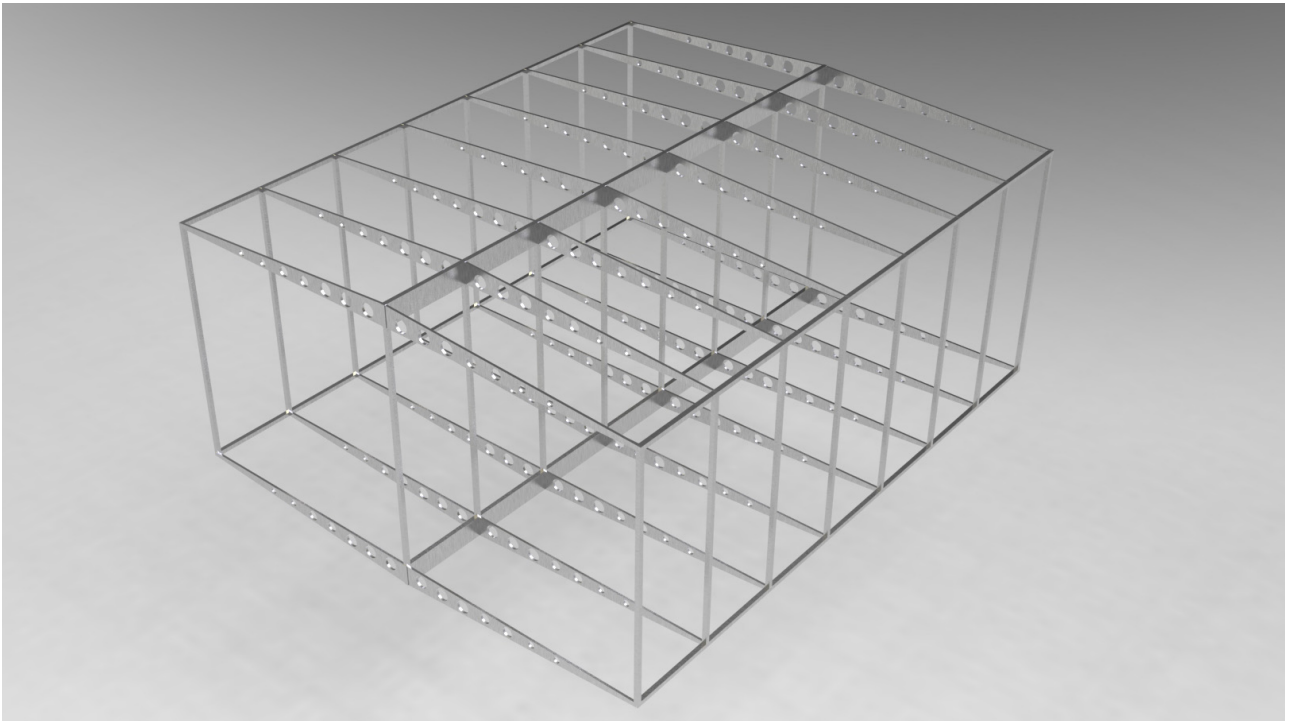
the ones of the singular module and the minimum dimension are the ones of a singular standard cabin. During the ethnographic observations on a cruise ship (Lillemäe, I. et al., 2012) it became clear that the height of a place correlates on the feeling of publicity in it, which means that the higher the room is the more public the feeling of the space is. (see figure 12) This notion became very important when thinking about the division of the space in a module. For the purpose of showing examples of different kinds of ways to divide the space four interiors were modelled – the basic 16-cabin, loft cabin, promenade and life boat modules. An example of the allocation of these modules in a ship is given later in this chapter when talking about the ship itself. (see pages

41 and 42)

As already stated in chapter 3 according to Simpson (2003) the primary tradeoff of the product platform design process including the modularisation is between commonality and distinctiveness, which in this case would mean the interior design of the modules including space division. The best way for the shipyard and the shipping company for choosing the most suitable divisions of the spaces in the beginning of the design process would be having a tool to help them in the decision making. The constraints and characteristics introduced in figures 11 and 12 could work as basis for the tool. Although it is not the intention of this thesis to design the decision making tool, the idea of a tool in the design process will be

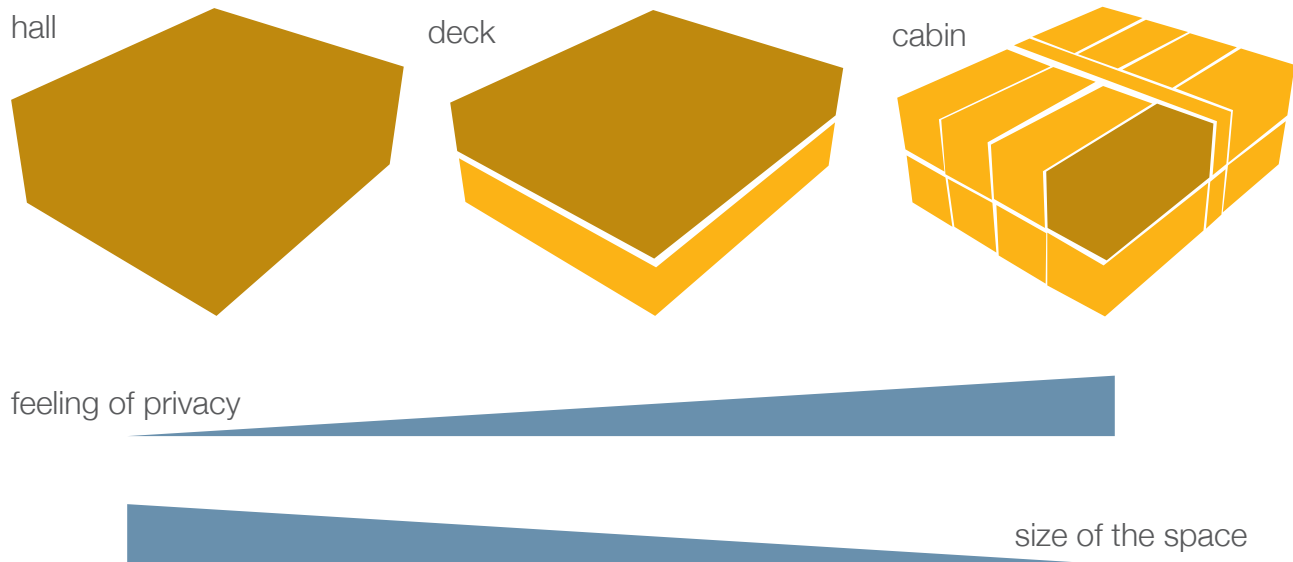


Picture 15. The construction of the customised spatial units with steel frame and modular walls. (Picture by Ramirent)

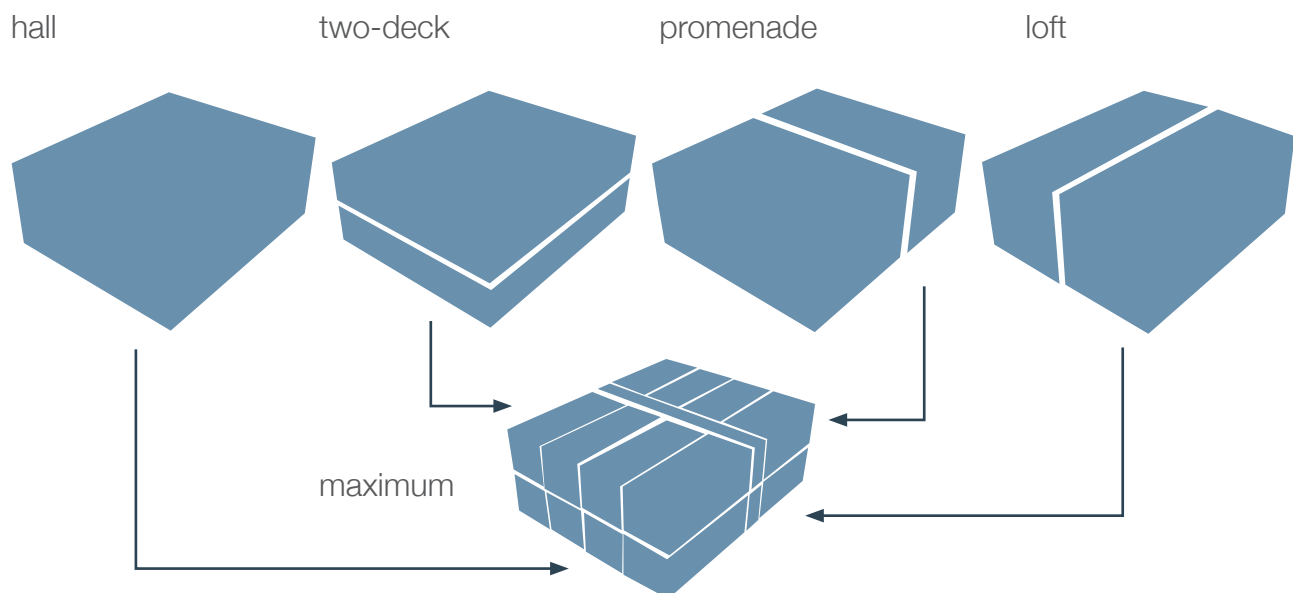


Picture 16 and 17. The construction of the m2cell module.

Picture 11. The feeling of privacy increases when the size of the space decreases. The module is big enough for different types of private and public areas.



Picture 12. The most common ways to divide the interior of the module. Maximum division will create the standard cabin size.





used when introducing the scenarios about changing the modules.

4.5 CHANGING TIME

According to the expert interviews (Interviewee 2, 2012; Interviewee group, 2012) the time to install one module depends on the time to lift it in its place and on the amount of interfaces linking it to other modules around. The lifting time varies on the routine of the workers and can be anything from one hour to half an hour (ibid.) whereas the time to install one of the interfaces takes roughly 20 minutes. As Kauppi (2012) has already defined the amount of interfaces to three, an equation of the time taken to install one module can be drafted as follows in the equation below. (see figure 13)

It must be noted that the whole time to change one module would be roughly twice the time of the installation because the old module should be first taken away. The relationship of the time to change

one module and the frequency of the changes will be further analysed later on in this chapter.

4.6 MODULES AND THE SHIP

The construction of the ship determined the amount of modules it can carry. In this project the engineering student, Oliver Parmasto, in his work determined the specifications related to the ship. The I-beam construction of the superstructure allows three layers of modules being attached to both sides of the ship, accumulating in a total of 6 decks of adjustable space. It was decided that the lowest layer of modules on the boat deck would carry all the lifeboats and the promenade modules whereas the two upper layers would be reserved for cabin modules. This division is based on the common division of space on a cruise ship and is used in numerous vessels throughout the world.

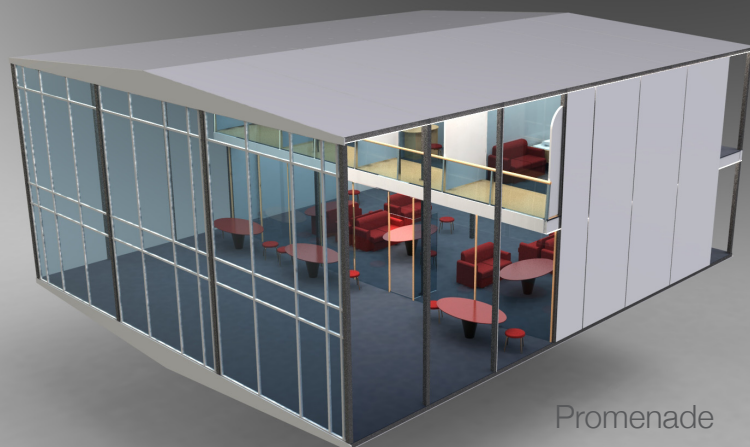
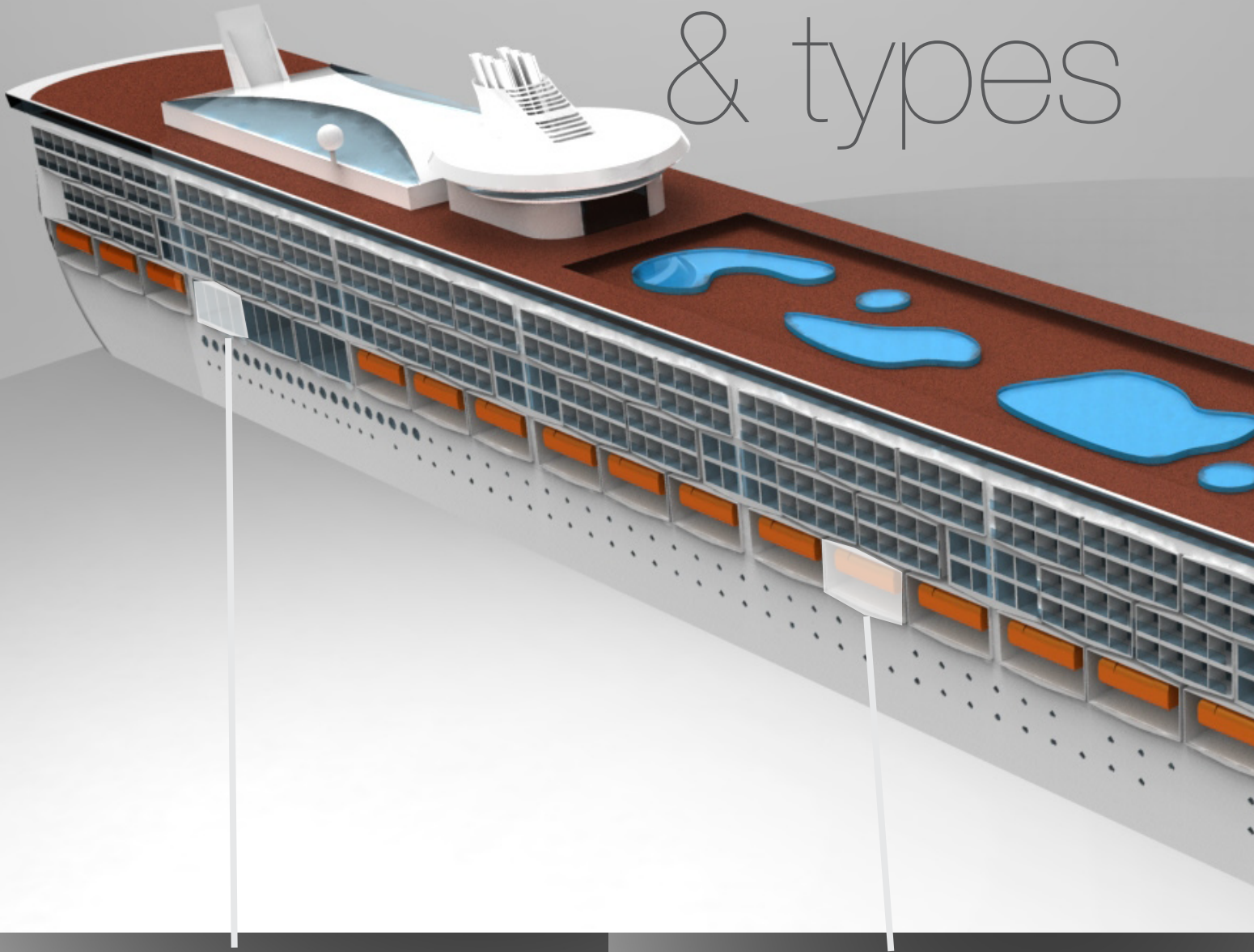
To give more credibility for the construction of the model *Freedom of the Seas* was used as an inspiration

Picture 13. Simplified equation of the time taking to install the modules

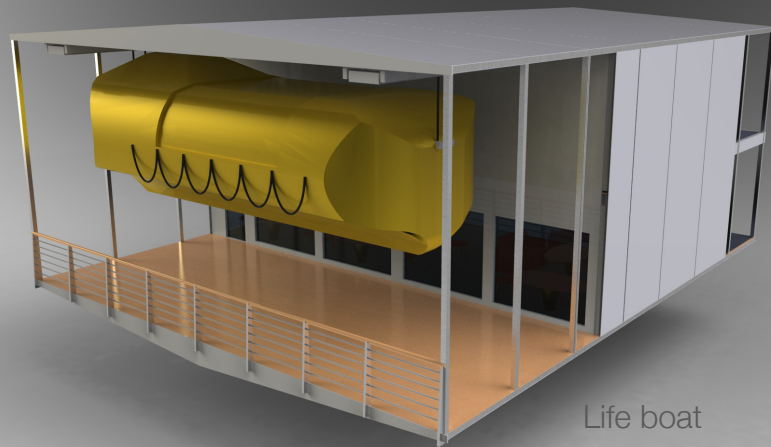
$$\text{time to install the modules} = \frac{\text{amount of modules} \times 30 \text{ min}^*}{\text{amount of cranes}} + \frac{\text{amount of interfaces} \times 20 \text{ min}^*}{\text{amount of worker groups}}$$

* According to an expert interview the time taken to lift the module in its place could be around 1 hour depending very much on the tools and expertise of the workers. If special tools present the time could be reduced. The installation of the interfaces to the superstructure is estimated from the time taken to install one cabin module to a ship. In the macromodule this would mean 3 macro-interfaces.

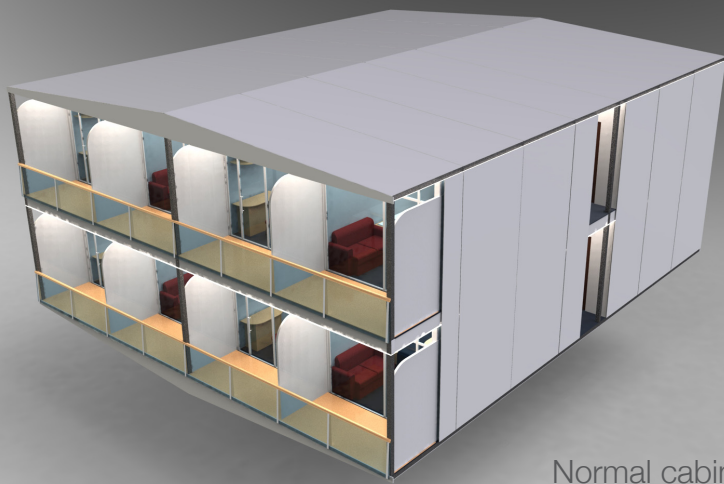
Module allocation & types



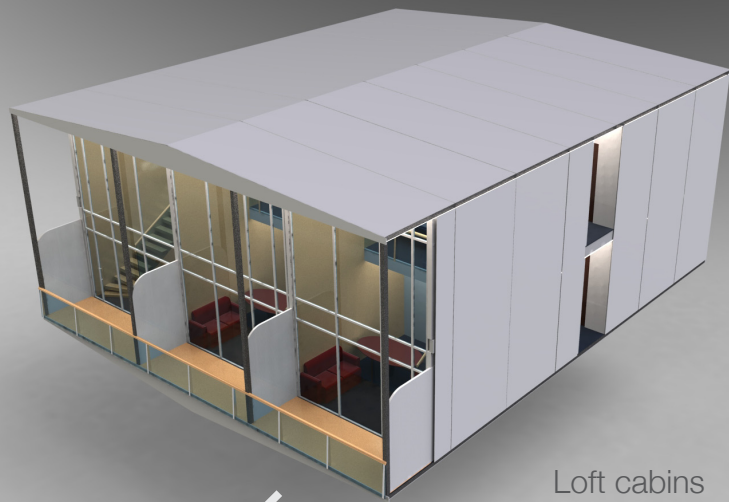
Promenade



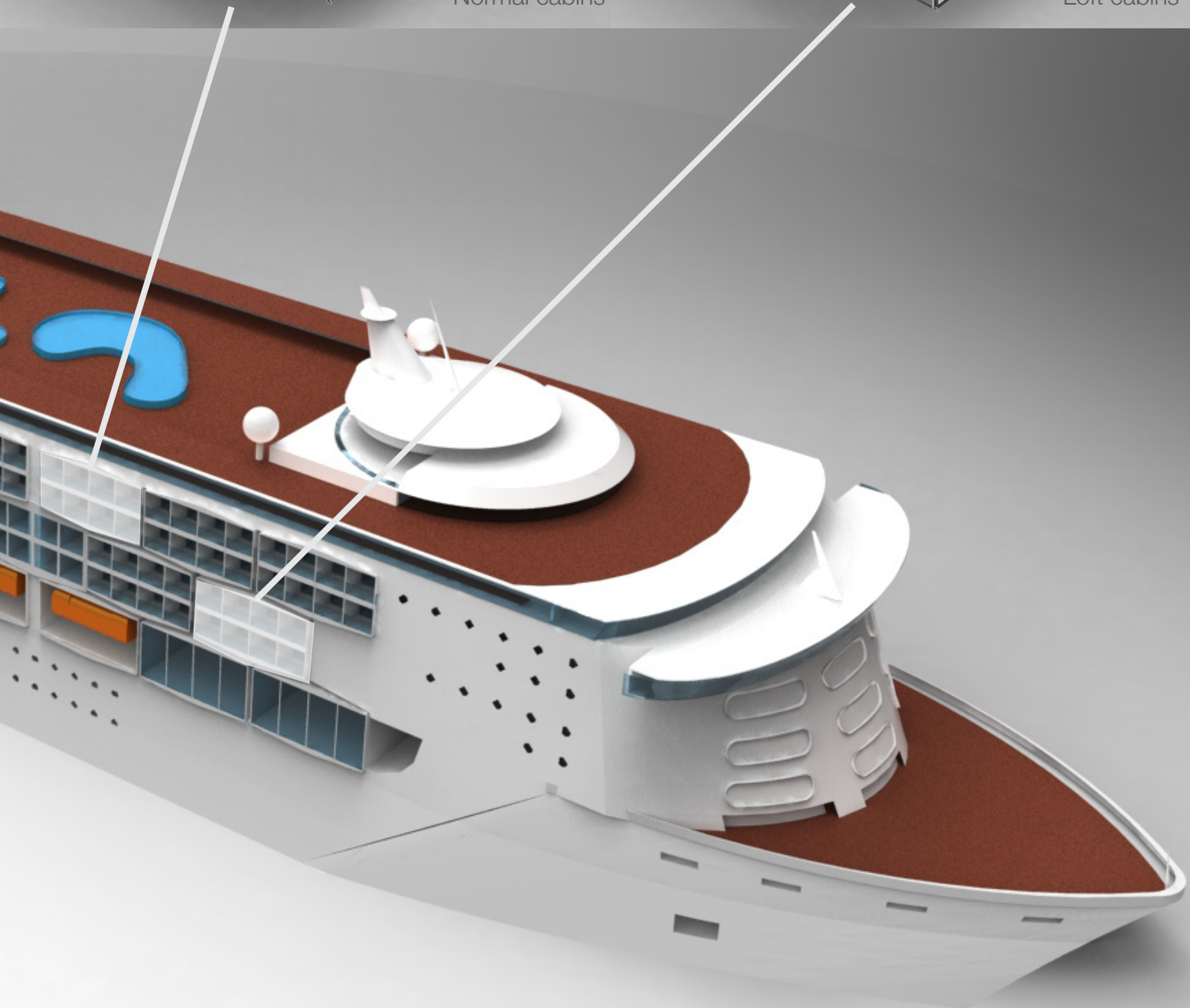
Life boat



Normal cabins



Loft cabins





for the visual part of the vessel as well as determining the maximum amount of passengers onboard.

With the two cabin module layers, 70 modules, the maximum capacity of passengers aboard would be ca. 2240 souls plus ca. 500 people situated on the hull cabins.

4.7 FREQUENCY OF CHANGE

During the design process four different frequencies of change of the modules were addressed (see figure 14), where the first one was to change the modules gradually in time according to their condition (Kauppi, A., 2012); the second one was to change the modules for every cruise; the third one was to change some of the modules every half a year according to the preferences of the different operational areas (Lillemäe, I. et al., 2012) and the fourth one was to change all of the modules every five years when the ship is undergoing bigger renovations (Interviewee group, 2012) (see appendix D).

When asked from the experts in various interviews the second option was seen problematic because of the too long a time taken to change one module and the fourth option was not seen to bring any considerable extra value to the industry. On the other hand the first and the third options were seen promising and bringing needed extra value either by answering to the different cultural needs or savings in renovation time. Because these two options are not excluding each other, they were taken as a basis on which to

build the scenarios of the system.

According to the interviews with members of the crew onboard *MSC Fantasia* (Lillemäe, I. et al., 2012) the ship is changing everything that can be changed in every six months as a response to the change in the operational area, which has been already stated earlier in this thesis. Unfortunately the structure of the ship doesn't allow any major changes in the interior design of the vessel and thus the adjustments are mostly about entertainment, menus, crew and accepted currency.

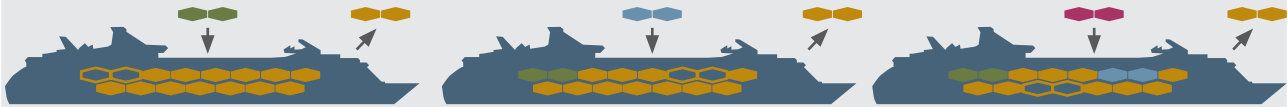
In some cases, according to the same interview, the ship hosts special events such as evening visits from classical orchestras, theme cruises with professional dancers and weddings with hundreds of guests. These theme events require fast adjustments of the space from the service providers and would gain some extra value from the modular construction of the ship, but unfortunately the time and effort taken to change one module for one-day use only would not be worth the extra value.

Figure 14. Different options for change frequency.

1

Change gradually in time

Time frame: A couple of modules in one year



2

Change per cruise

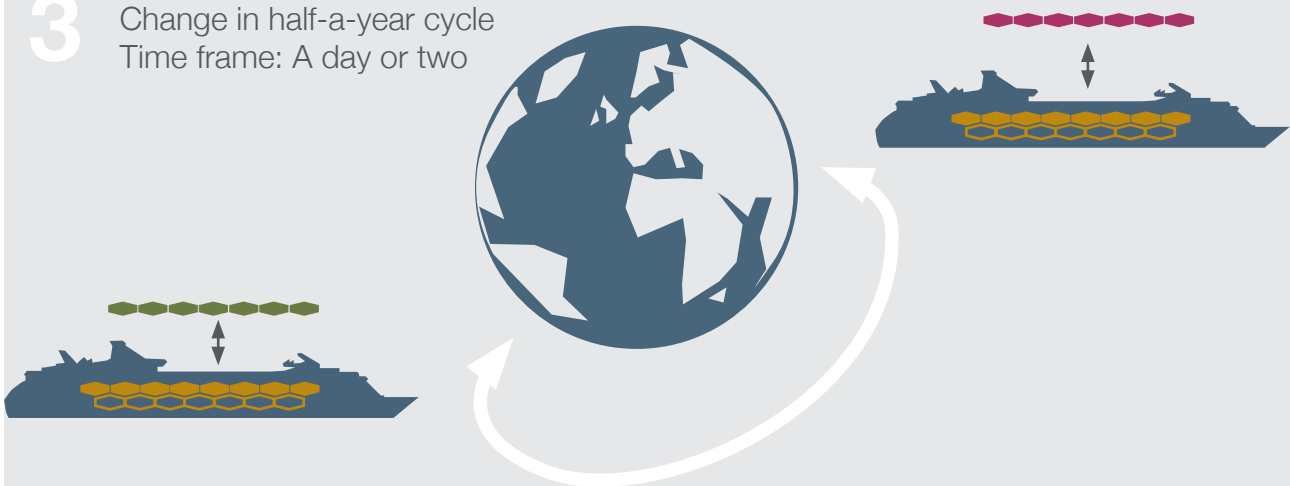
Time frame: One night



3

Change in half-a-year cycle

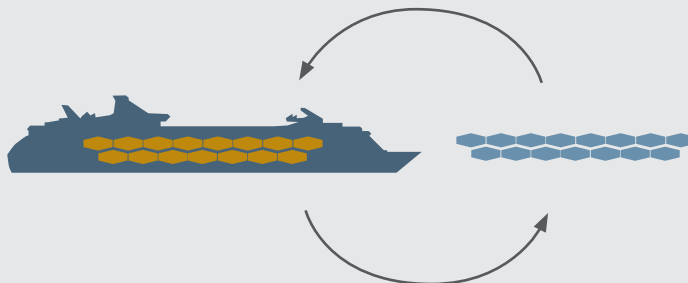
Time frame: A day or two



4

Change in five-year cycle

Time frame: A week





Picture 18. Visualisation of the M2Cell cruise ship in operation.



■ CHAPTER ■

5

Simulation

In this chapter the scenario, which is built from the parts introduced in the analysis chapter, is presented in full detail. The description of the final system includes system map, introduction of the whole M2Cell fleet as well as annual plan for system operation and finally the change structure break down diagram explaining in step-by-step manner the whole change process.

The objective of this chapter is to bring the further developed interchangeable system into life by pro-

viding enough data to help the reader in the mental simulation process.



5.1 MODULE SERVICE SYSTEM

The module service system defines the companies involved in the interchangeable module cruise ship industry and their area of expertise. (see figure 15) In this simulation there are three major organisations involved, the shipyard, module company and the shipping company. The duty of the shipyard is very similar to the situation nowadays including building spare parts and frames for the modules rented out by the module company. Because there will be a tremendous amount of modules even if only three modular ships were built it is logical to establish an independent module renting company, *Module Ltd.* in this simulation. The duty of the module company is to perform the maintenance work for the modules, rent them to the shipping companies and design the interior of the modules according to the taste of the shipping company.

The role of the shipping company stays the same as it is nowadays including the planning of modules changes during the year and ordering the change procedure from the module company. In this system the end user is the shipping company, the product side producer of the service is the shipyard and the service itself is provided by the module company.

By having an independent module company renting out the modules it is possible to serve multiple shipping companies and at the same time reduce the amount of storage time for the modules, because

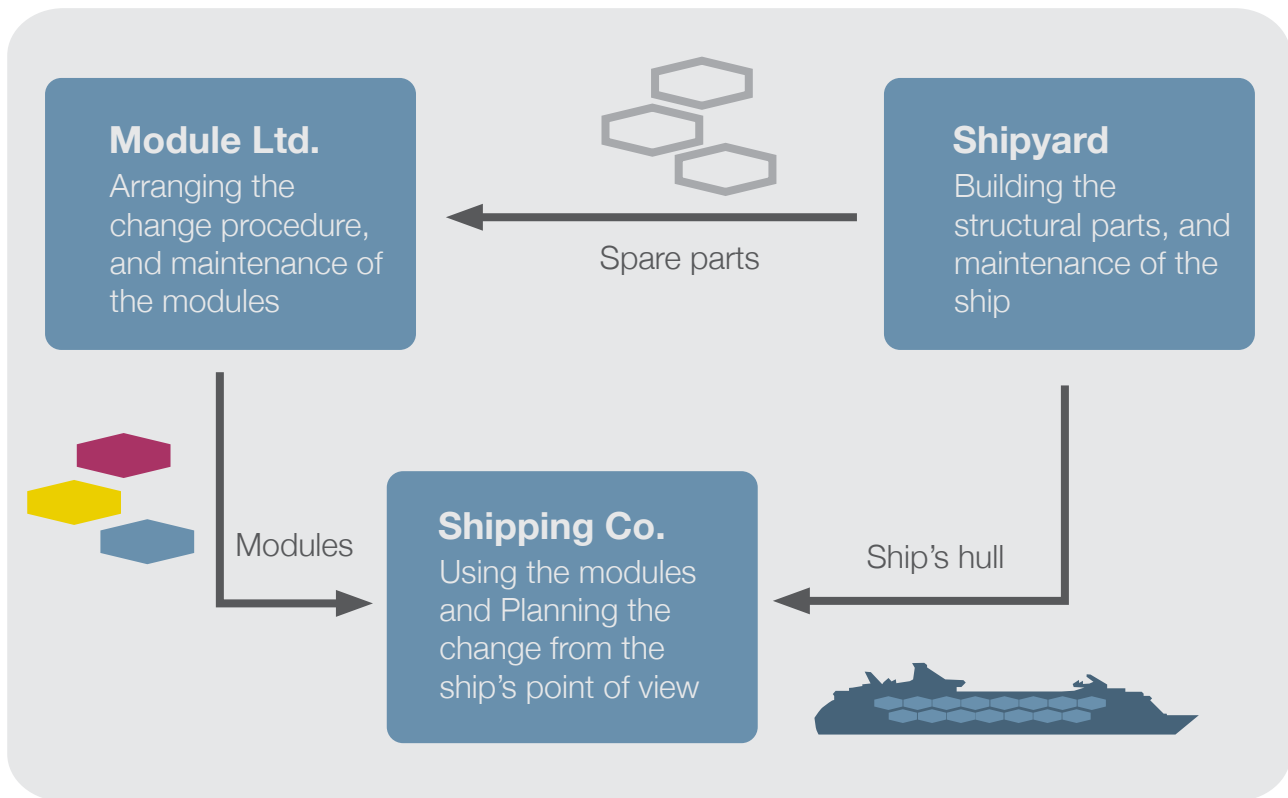
in this way they can be utilised in a ship belonging to another shipping line. On the other hand dealing with hundreds and even thousands of modules seems to be too much of an effort to the shipyard to handle.

The very basis for this refined module system came from the insights gathered from the expert interviews. According to various fields of expertise the ownership of the modules were either held by the shipping company or an independent module corporation. The interviewees who wanted the shipping company to own the modules said that the reason was about small-scale business – if only one company was using the modular system no independent module service provider was needed.

The people who were suggesting having an independent module company said that even if at first there was just few ships with modules the option of having more shipping companies interested in the innovation in future is probable. In their opinion the module company could, at first, be part of the shipyard as a special department and later establish itself as an independent company.

In case the independent module company is established the best practises from the container renting company can be applied – buying the frame already fixed from manufacturers, renting the finished product out for a third party and doing the maintenance

Figure 15. Simplified map of the whole module service system covering the roles of the main actors.



work after use.

It must be noted that the module could be used for other purposes as well such as transportable hospital or research centre that can be lifted on places where a fast and yet rigid structure is needed. At the same time some of the stored modules could be used as building blocks for temporary hotels during an off-peak season in similar way as used sea containers are used today in many places.



5.2 THE M2CELL FLEET

To provide an understandable scale for the simulation a *M2Cell* fleet is introduced (see figure 16). In this way the six main cruising areas in the world (Jantunen, O., 2011) can be covered by changing the operational areas every half-a-year. To show the full potential of the module system's adjustability cultural differences of the operational areas are underlined, and the routes for the cruise ships are chosen so that this contrast between the two areas is as noticeable as possible. The main similarity between all of the routes is them all having a port for changing the modules during travel from one area of operations to another. (see figure 17 and picture 19)

The first cruise ship called *Freedom of North Atlantic* operates on both sides of the North Atlantic ocean staying during the winter seasons in Bahamas and Caribbean and after changing the modules in *Grand Bahaman Shipyard* in Freeport continues to Scandinavia for the summer seasons. The differences in cruising culture, climate, length of cruises and the environment make this entity a perfect example for deeper evaluation in the latter part of this chapter, where the whole transformation from party ship for short cruises to culture ship for inner and outer wellbeing is explained.

The second cruise ship called *Freedom of South Atlantic* operates on the southern part of Atlantic Ocean and on the whole of Mediterranean Sea. Inspiration for this entity came from the *MSC*

Fantasia cruising on the western Mediterranean during summer seasons and near Brazil during the winter. (Lillemäe, I. et al., 2012) Although both places have Latin influences and historical monuments the differences in culture, climate and cruise length provide a reason for changing the modules during the travel from one area of operations to another. For this entity a port for changing the modules is in Algeciras in Spain.

The third cruise ship called *Freedom of Pacific* has the longest distance between the two areas of operations in length as well as in cultural differences ranging from the north American cities near the Alaskan glaciers to the southeast Asian temples in the jungles of Thailand. The port for changing the modules in this case would be in Yantai, China, one of the biggest ports in the world.

Generally speaking the interior design of the module reflects the features related to the operational area in question. For example the Southeast Asian area's features are a collection of the preferences taken from Ahola's thesis (2011) and styles related to the specific area in *RCCL's* advertisements (*RCCL*). One of the most important features, regarding all of the three cruise ships and their areas, is the length of the cruise, which determines the size of the cabins and the size and structure of the rescue equipment; the longer the cruise the bigger the cabins should be and on the other hand on short cruises next to the sea shore the lifeboats can be substituted with life rafts taking less space in the ship.

Figure 16. The M2Cell cruise ship fleet with the seasonal operational areas and port for change marked.

Freedom of North Atlantic

1



Winter: Caribbean
 - 7-day cruises
 - partying
 - beaches

Summer: Scandinavia
 - 11-day cruises
 - culture
 - cities

Port for changing modules:
 Grand Bahama Shipyard,
 Freeport

Freedom of South Atlantic

2



Winter: South America
 - 4-7-day cruises
 - history
 - beaches
 - partying

Summer: Mediterranean
 - 7-11-day cruises
 - culture
 - cities
 - history

Port for changing modules:
 Algeciras in Spain

Freedom of Pacific

3



Winter: Southeast Asia
 - 9-day cruises
 - nature
 - cities
 - casinos

Summer: Alaska
 - 7-day cruises
 - nature
 - wildlife
 - cities

Port for changing modules:
 Yantain in China

Figure 17. The three routes for the M2Cell cruise ships cover the main operational areas of cruise industry.



 Port for changing modules

 Operation route for the Freedom of North Atlantic

 Operation route for the Freedom of South Atlantic

 Operation route for the Freedom of Pacific



5.3 SCENARIOS

The scenario starts in Grand Bahama Shipyard in Freeport in October 2015. The *Freedom Of North Atlantic* has just undergone a 12-hour module change procedure, where a total of 20 macro modules have been changed for the upcoming 8 months on sea near the Bahamas and Caribbean. For the past three years the shipping company has been gathering valuable data of the newly established module system by encouraging the customers and crew to give feedback of their experiences onboard the module ships. The first years have been a time for learning the new system and adjust the operation modes so that all the actors involved can work efficiently together. Now is the time to show the results of that learning process and provide the customers what they asked for.

The theme for the upcoming year of operation, from October 2015 to October 2016, has been named “*R and R*” – retro and royal. The idea behind the theme is the celebration of 50 years of cruising in Bahamas, which will be an independent theme for the American operational area of the ship, and celebrating the past and present Royal families across the Baltic Sea, which will appeal to the clientele in the Scandinavian operational area. The planning of this specific year has already started in 2013, when a five-year plan was made for the whole fleet (see figure 22). The objective for the plan was to create a framework for the future operation of the fleet by deciding key themes for each year

on which to build the campaigns. In the beginning of the planning in 2013 the operational year 2015-2016 was merely described by the 50th anniversary of cruising in Bahamas, but after the first two years of operation the feedback of the crew and passengers and arising interest in old and new royal families had shaped the whole year into a plausible concept that was then marketed to travel agencies across the globe. The advertisement campaign was released in 2014 and the tickets for the first months were sold out in the beginning of 2015.

Logistically speaking the arrangements for the change procedure had started already in 2014, when the change timetable had been approved with the shipyard and the shipping company. At the same time the spare parts and frames for new modules were ordered from the shipyard and the timetable for refurbishing the used modules was agreed upon. Only minor changes were made during 2015 regarding the café areas and special restaurants, which were rented to a third party service providers during the marketing campaign.

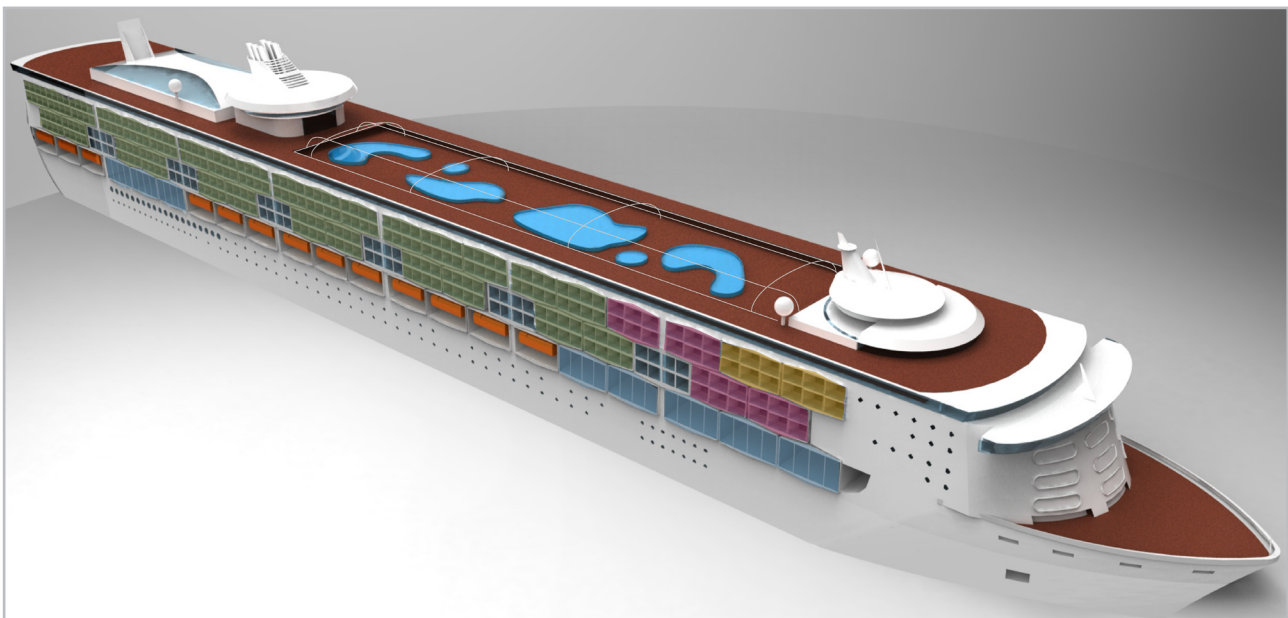
5.3.1 SCENARIO 1. BAHAMAS AND CARIBBEAN

The *Freedom of North Atlantic* starts its journey to Bahamas and Caribbean from the Freeport Shipyard with module arrangement specially designed for this occasion. Because having shorter cruises, between 4 and 7 days, there are more small cabins aboard the

ship compared to the Scandinavian cruise waiting next summer. (see figure 18) The idea is to provide a retro party cruises for a large variety of customers by increasing the amount of cabins in favour of the economy of scale in prices.

In the cruise program there are several classic island destinations underlining the cruise experience being

Figure 18. The module arrangement for the Caribbean and Bahaman operational area.



a total of 58 modules with 16 standard cabins



a total of 8 modules with 12 bigger cabins



a total of 4 modules with 12 luxury cabins



a total of 16 modules with promenade area



a total of 26 modules with lifeboats (for 3900 people)

Total amount of passengers and crew: 3525

of which 2144 passengers can be accommodated in the modular cabin area and 500 in the hull.

all about sand, sea and the sun – as it was already 50 years ago. (see figure 19) Reminding of the retro theme numerous cabins are decorated accordingly to different decades of the Caribbean cruises and the entertainment onboard concentrates on experiences from the grand era of modern cruising.

Figure 19. The first operational area consist of many classical places in the Caribbean and Bahamas.





NASSAU

November 2015





5.3.2 MODULE CHANGE BETWEEN OPERATIONAL AREAS

The *Freedom of North Atlantic* operates in Bahamas and Caribbean from October 2015 till the end of May 2016 after which it returns to Freeport for changing the modules before crossing the North Atlantic Ocean to the Baltic Sea. (see figure 23 for the step-by-step change procedure)

During the last week before the change operation the shipping company reminds the cruise ship and the shipyard about the upcoming procedure, and the crew onboard starts to prepare the ship by packing their personal belongings and cleaning the whole cruiser from excess material.

At the same time the shipyard prepares the new modules for the change by placing them in right order and securing that all material needed is ready for the operation.

After the arrival of the ship and the disembarking of the passengers and the crew the vessel is towed to the module changing area. (see picture 19) In this area six groups of module workers enter the ship to release the old modules for four cranes to lift them out. After this the new modules are lifted in and installed by the workers. In this case the module arrangement changes so that the amount of basic cabin modules with 16 identical cabins is reduced from 58 to 46 allowing the amount of bigger cabins to be increased from 12 to 20 and four additional loft cabin modules to be introduced. Because the total amount of cabins is reduced, simultaneously

decreasing the total amount of passengers, two lifeboat modules can be replaced by extra promenades. (see figure 20)

Because of the unpredictable weather conditions in the north a glass cover is installed on top of the sun deck allowing the customers to enjoy the pool areas even during the colder days with rain.

As stated before the change procedure takes 12 hours to complete after which the ship is towed back to port, where the crew is introduced to the new spatial arrangements. After a full security check and emergency training, new customers are welcomed aboard and the ship leaves Freeport for the old continent.



Picture 19. In Freeport some of the old modules are changed to new ones by using big cranes and special vehicles.

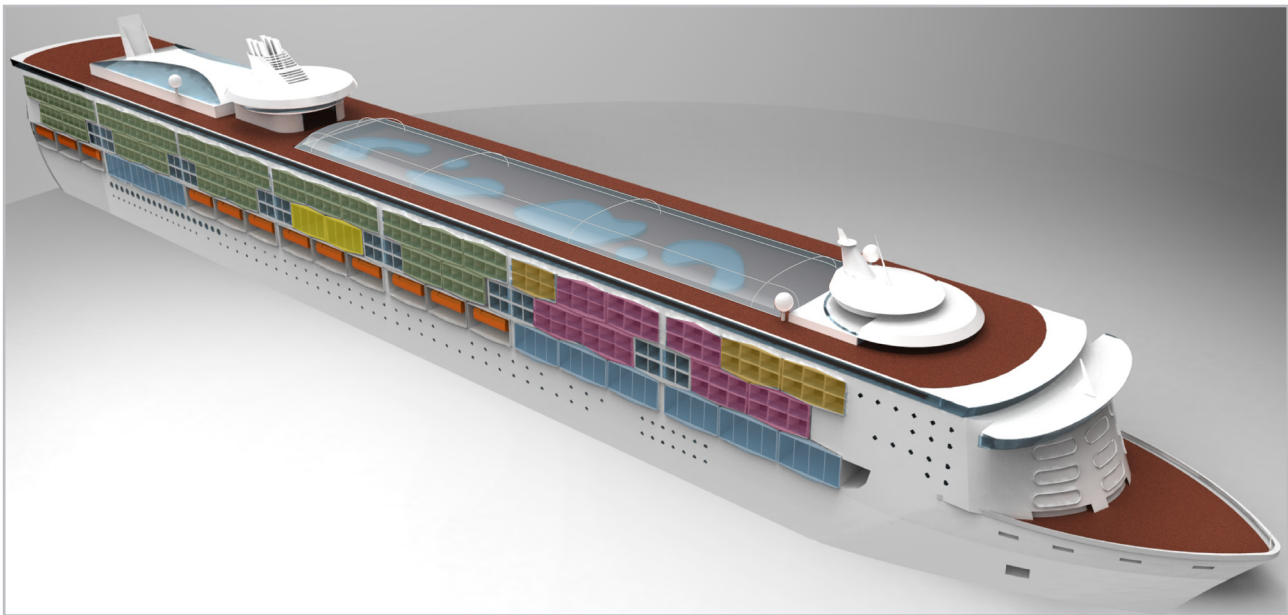
5.3.3 SCENARIO 2. SCANDINAVIA

The cross-Atlantic journey gives an opportunity for the crew to further familiarise with the new environment on the ship before the hectic time on the Baltic Sea.

The theme “*Royal families across the Baltic Sea*”

reflected from the luxurious interiors of the cabins and public areas underlines the posh clientele expected to cruise onboard *The Freedom of North Atlantic* while operating the four summer months in Scandinavia. The reduction in amount of passengers and increase in the cruise length means

Figure 20. The module arrangement for the Scandinavian operational area.



a total of 46 modules with 16 standard cabins



a total of 14 modules with 12 bigger cabins



a total of 6 modules with 12 luxury cabins



a total of 18 modules with promenade area



a total of 4 modules with 3 loft and 6 luxury cabins



a total of 24 modules with lifeboats (for 3600 people)

Total amount of passengers and crew: 3365

of which 2024 passengers can be accommodated in the modular cabin area and 500 in the hull.

higher ticket prices and specialisation in high-end customers such as Russian businessmen and upper class Europeans. The preferences of this specific customer group (Ahola, 2011) is met by providing wider SPA services inside the glass covered sundeck, culinary experiences in various restaurants and increasing the amount of crew per passenger.

The destinations cover all the great royal cities of the north from the lively Copenhagen, the home of various modern royal families, to St. Petersburg, the pearl of the Russian Tsars. The objective of the summer cruises on the Baltic Sea is to bring internal and external wellbeing for the passengers willing to pay for the royal treatments. (see figure 21)

After the four months of cruising the *Freedom of North Atlantic* returns to Freeport for yet another change of modules just to start its journey in Bahamas and Caribbean again with another great theme in mind.

During the time of operation of the ship the shipping company keeps track of everything happening onboard being able to react to any unwanted situations such as lack of passengers or lack of interest in some parts of the ship. In these two cases various solutions are possible varying from shutting down individual modules for saving expenses to changing few modules during a visit to a port.

Figure 21. The second operational area consist of many Nordic capital cities.





HELSINKI

June 2016



Figure 22. The yearly plan for module system operations with continuous planning and evaluation process.

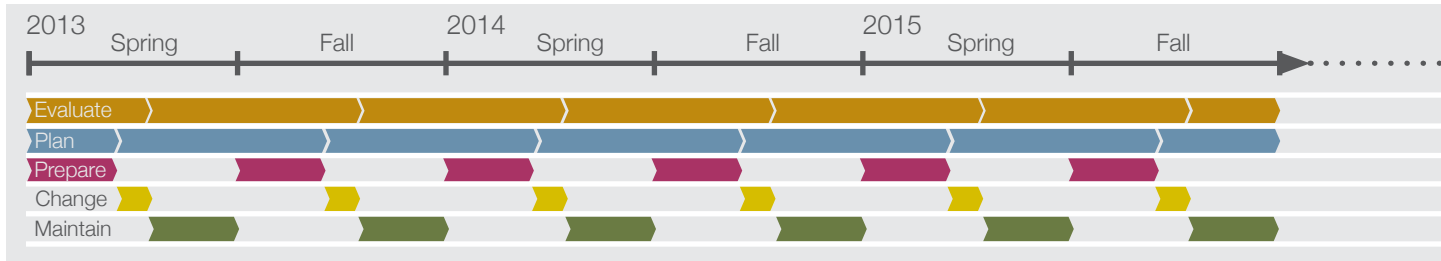
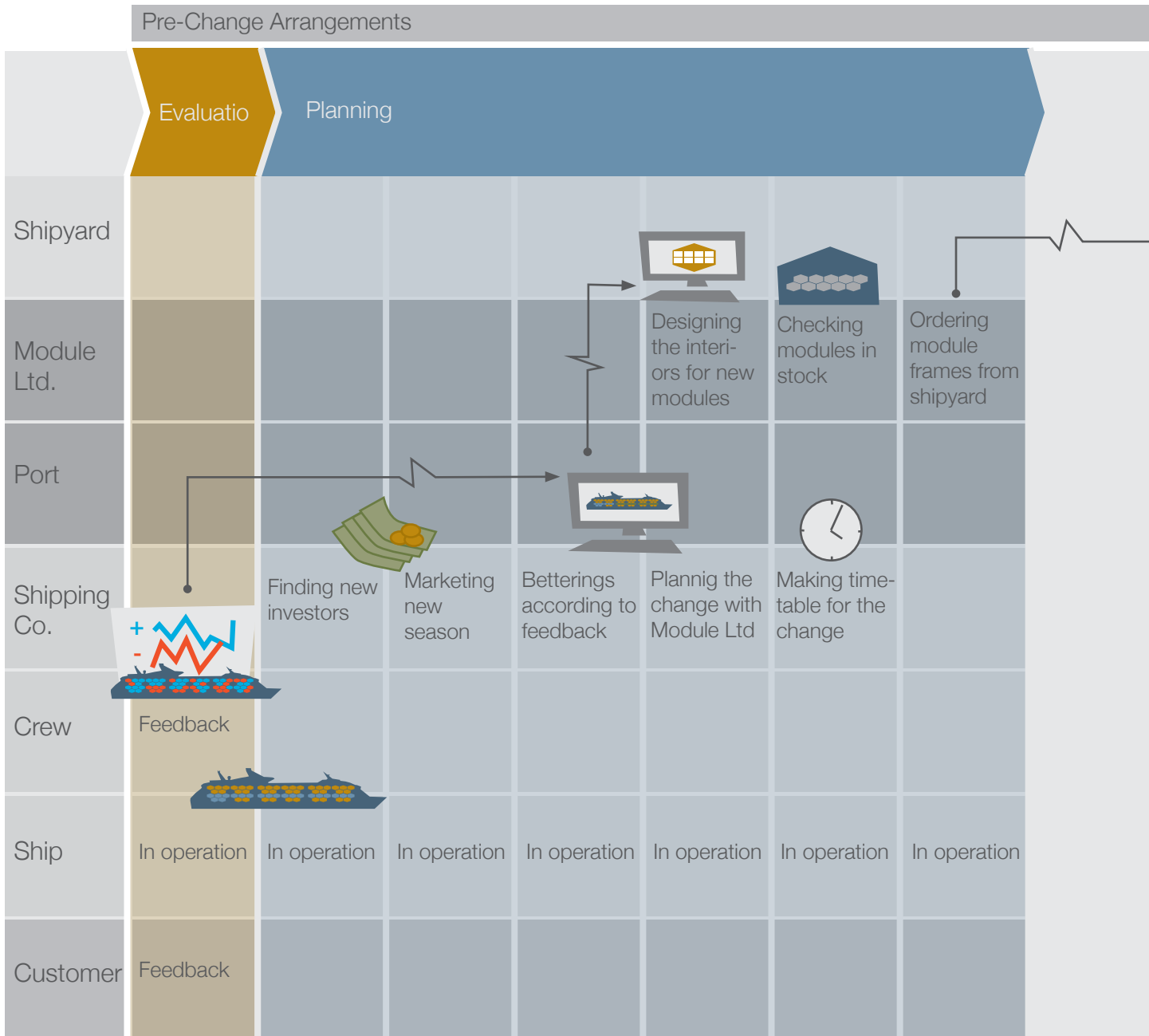
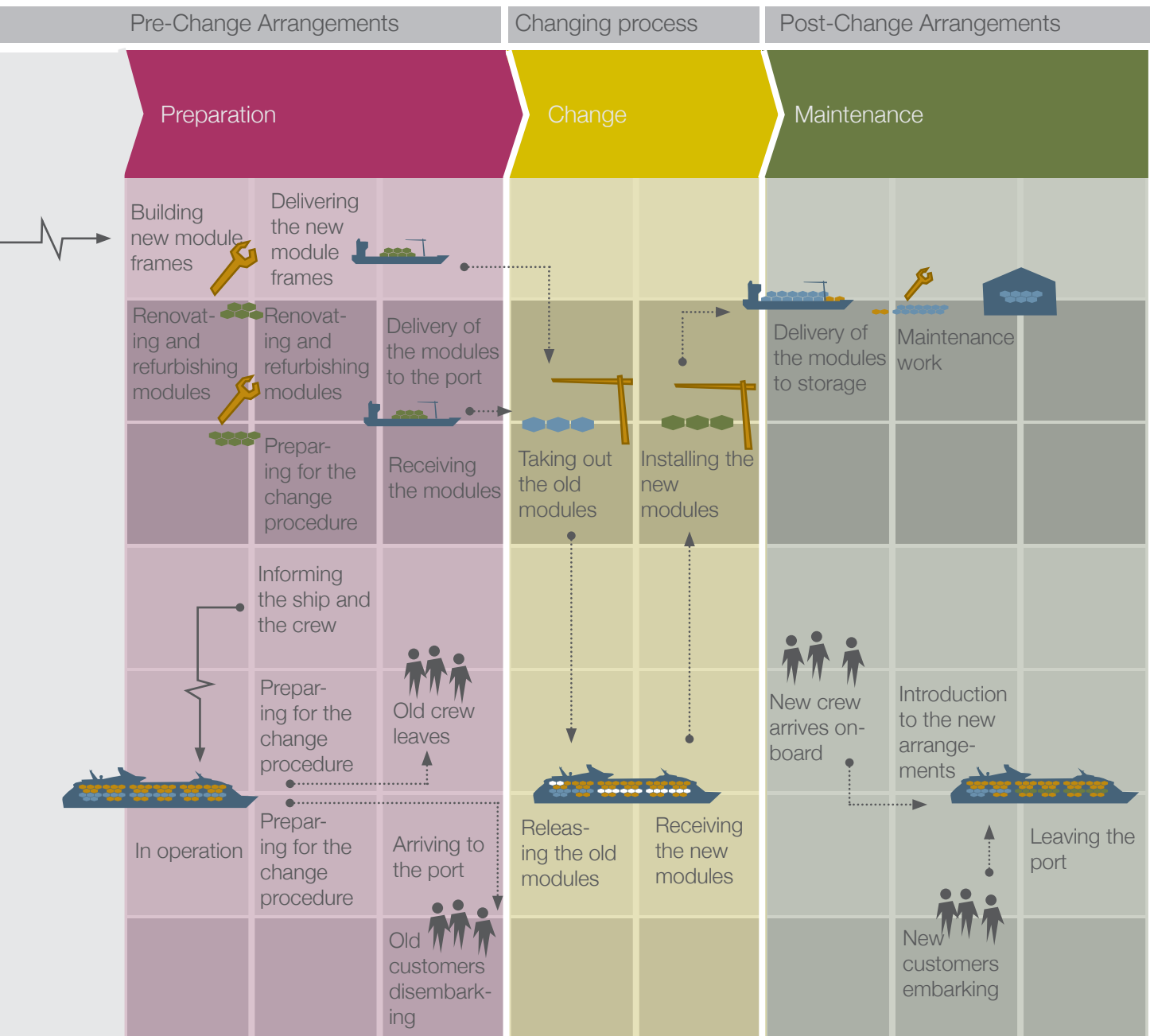
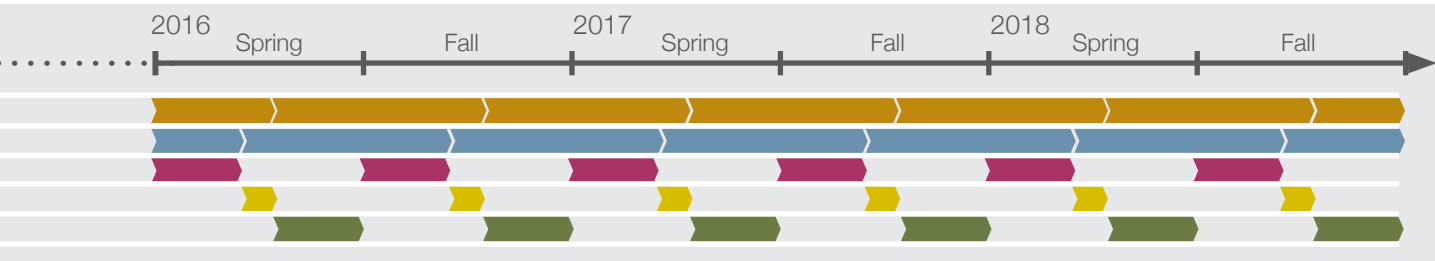


Figure 23. Change structure break down diagram of one change procedure from evaluation to maintenance.







*Picture 20. One of the topics for further reseach is the use of the modules as houses. In this picture an ex-
ample of a building created from old shipping conatiners called "Container City" in London.*



■ CHAPTER ■

6

Discussion

In this chapter brief answers to the research questions are given together with a few suggestions for further research and an analysis of the designer's role in the whole project. Because of the nature of the project some of the results are too wide in scale to be listed in this chapter. It is recommended to read the whole thesis for understanding the real value of the research.



6.1 ANSWERING THE RESEARCH QUESTIONS

What is needed for changing the modules?

The answer for this question is divided into two sections, organisational and structural. From the organisational point of view three different actors are needed – the shipyard that builds the ship and the modules, the shipping company that uses the ship and the modules and the module company that maintains, stores and rents out the modules.

From the structural point of view a big enough port is needed with special cranes to execute the change procedure as well as a special built cruise ship with interfaces to lock and release the modules when needed.

How would the system look like in operation?

The biggest differences in the new adjustable module system compared to contemporary system related to cruise ship operations are linked to the change procedures of the modules taking place every half-a-year. The continuous evaluation and planning linked to the pre-change arrangements of the modules are already normal features of the quality control in today's cruise business but the preparation for the change, the actual changing and maintenance of the modules is something new for the industry.

For passengers the cruise experience would not change at all excluding the fact that the shipping company would be able to adjust faster to the upcoming trends in the business and answer better

to the customers' preferences.

What kind of impact does the simulation have on the structure of the module?

As seen in the chapter 4 the size and structure of the module was questioned and various choices were introduced after which the hexagon shaped macro module was chosen as a final shape and the structural issues were fixed.

During the whole process it became clear that the interfaces and locking system of the module should be developed further so that the time frame for changing, as seen on page 40, could be reached. At the same time the constraints and characteristics of dividing the interior of the module, introduced on the same page as the changing time, will help in the design of the preferred interior solutions.

6.2 FURTHER RESEARCH

Further research is suggested from the module's structural point of view including the interfaces and locking systems, from the module system's economical point of view including feasibility of the whole system, and from the module's life cycle point of view including storing and additional applications (see picture 20)

Eventually the value of this thesis was to give a visualised analysis of the M2Cell innovation in operation in contemporary context for the real cruise industry to understand whether the concept is worth further investment and development or not.



DESIGNER'S ROLE IN THE TRIAD 2012 PROJECT

The *Triad* project has been full of opportunities and challenges especially from the designer's point of view. The excruciating silence after my first presentation for the partners opened my eyes for the fact that designers and engineers don't have a common language. While the former ones are speaking about feelings, experiences and even intuition the latter ones are waiting to hear about measurable data or in this case where the chairs and curtains should be placed.

The positive aspects of my time in the *Triad* project are linked to the opportunity to learn a lot about marine industry and at the same time use the design tools gained during my five years of studies. The interdisciplinary environment and cooperation with real industry forced me to trust my skills and make myself heard as an equal researcher in the *Triad* team. On the other hand working in the *Marine Technology* building influenced the team's work by being a non-neutral environment; where technology and engineering has a strong say in everything. This power imbalance was seen in the weekly conversations, where the economist and the designer were merely seen as stereotypical representations of their profession undermining the actual individual, professional capabilities. It must be admitted that working in an interdisciplinary project, where students are chosen from three different fields of expertise, the underlying expectation might be

to see the individual contribution clearly in the end product. This way of seeing the collaboration might work with engineering and marketing, which both can be separated from the end product, but pinpointing the design in the end product is much more complicated.

Throughout the project I have been working as a graphic designer building the presentations for the meetings, as a consultant trying to find a common understanding for the project, as an Italian, German and French translator during our cruise journeys, as a photographer, documentarist and social scientist observing the behaviour onboard the cruise ship and interviewing executives from different companies, as a historian telling stories about the century of liners on the North Atlantic, as a product designer modelling the 3d model of the module and the ship and as a service designer creating the system map and scenarios. The whole project has been like a long act in theatre for the designer, who jumps from one role to another using the tools gained through years of studies and empathy that helps him to imagine the world from someone else's point of view in different time and place. It is these instruments that help him to bring the innovation from the idea world to life for a brief moment for others to examine it. Unfortunately for some he appears to be like a child playing with the building blocks on the sea.



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Appendices



SHIPYARD INTERVIEW QUESTIONS, RAUMA 14/03/2012:

When is it possible to build this kind of modules?

How often the module could be changed?

How long does it take to change one module?

Are there or will there be in near future structures that make the change of the modules possible?

Where these modules could be stored?

How much expenses would there be from the storing the modules?

Which kind of storage levels should there be from your point of view?

How these modules could be built?

Who would own these modules?

How often the interior would be changed? (after every cruise, monthly)?

The life span of one module:(more or less than 5 years)?



SHIP INTERIOR AND MODULE COMPANY INTERVIEW, UUSIKAUPUNKI 26/04/2012

Initial questions:

- Could this kind of module system be built?
- How could these modules be built?
- What could one build inside these modules?
- Are there any structural limitations in the module?
- What would be the lifespan of the module?
- How could these modules be changed?
- How long would it take to change one module?
- How could the modules be stored?

Interview questions:

- How long does a cruise ship renovation take today?
- How long does it take to build one of your modules?
- What kind of work phases is there in building a module?
- Are there some standardised procedures for building a ship/module/whatever structure?
- How long does it take from meeting the customer to the moment the module is ready?
- Where are the parts of the modules stored?
- Where does the line between a shipyard and your company (building interior modules) go?

M2Cell:

- How long would it take to build one module?
- How long would it take to install one module?
- How long would it take to take out one module?
- How long would it take to plan and build one module?
- How long would it take to plan a change for the modules?
- Who would be involved in the changing procedure (before, during and after)?
- Could these interchangeable modules be built and what would be the most important features in them?
- What is more feasible building small modules or big macro modules?
- Should the macro module be divided to smaller parts (modules in modules)?
- Where would these modules be stored?
- What would be the best change frequency?
 - Every cruise (customisation)
 - Every half-a-year (cultural preferences)
 - Every year (special theme)
 - Every 5 years (renovation help)
 - Just when needed (change in trends, reaction)



CONTAINER RENTING COMPANY INTERVIEW QUESTIONS, VANTAA 21/05/2012

The life cycle of one space/container solution

How long does it take to plan and put to action one space/container solution?

Do you have some sort of a standardised package for this?

Preparatory process:

Where does the project begin?

What are the important things in the planning process and why?

When does the planning start? How long does it take?

Who are involved in the planning process? Who builds the modules, maintenance, where are they stored?

Using the containers:

How are the containers brought to the site?

What is the average transportation distance? Longest? Shortest?

When does the building begin? How long does it take (installing water, electricity and air conditioning)?

What needs to be ready before transportation?

Who are involved in the transportation process? How many people, how many organisations?

Are there some changes being done to the container during the use? What?

Moving back the container:

When does the preparation for moving back the container begin? How long does it take?

What are the most important things about moving the container?

Who are involved?

Where is the container moved? Where is it stored?

Workers:

How are the workers and the customers trained for using the containers?

How are the security precautions taken care of?

Services and spaces:

Are you flexible about customer's ideas? Do you do special deliveries?

What new ideas are you planning to introduce to your business? What old conventions have you stopped using?

Do you know why people are using your services?

Are the containers being renovated very often? Are the interiors changed or not?



SHIPYARD INTERVIEW QUESTIONS, TURKU 04/05/2012

What and who are needed for changing the modules?

Which organisations and actors would be involved in changing the modules?

Where would the changing procedure happen?

What would be a realistic change frequency for the modules?

When should the modules be changed?

- Every cruise (customisation)

- Every half-a-year (cultural preferences)

- Every year (special theme)

- Every 5 years (renovation help)

- Just when needed (change in trends, reaction)

How and where the modules should be stored?

- Container park

- Container hotel

- Destruct and build again if needed

- In use all the time – rotation

How this change frequency would affect the structure and size of the module?

Smaller or bigger?

The shape of the module is good or it should be changed?

There is no need for inside cabins?



FAIR CENTRE INTERVIEW QUESTIONS, HELSINKI 06/06/2012

Define with a few topics the lifespan of one affair.

How long does it take to plan and execute one affair?

Do you have a standardised package for these events?

Preparations:

Where does the planning of an event start?

What are important things when starting to plan an event? Why?

When does the planning begin (compared to the opening of the event)? How long does the planning take?

Who are involved in the planning/preparatory process?

Building:

How does the building and planning of the event link together?

How is the building executed?

When does the building start? How long does it take?

Which things must be ready before starting the building?

Who are involved in this part of the process? How much people, what about the amount of organisations?

The event:

How do the planning, building and the event itself link together?

Are there any structural changes made during the affair?

What? Where? How? By who?

Dismantling:

When does the dismantling begin?

What are the important things in this part of the process?

Who are involved?

What is the relationship of the dismantling to the next event in the affair centre?

Are the people same ones building and dismantling the event?

Informing and the staff:

When does the staff know about a new event?

How is the staff trained for the continuously changing environment?



Services and spaces:

What services are you providing during the event? Which services are you outsourcing and why?

Are you flexible about the wishes of the customers? Are you doing any special demands?

What new ideas are you introducing to the organisation? Which conventions are getting old?

Have you any idea why people want to arrange events in the affair centre?

Which spaces are stable and which ones are transformable?

